OBSERVATIONS

ON THE

STRUCTURE, ŒCONOMY, AND DISEASES

OF THE

FOOT OF THE HORSE.

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OBSERVATIONS

ON THE

STRUCTURE, ŒCONOMY, AND DISEASES

OF THE

FOOT OF THE HORSE,

AND

ON THE PRINCIPLES AND PRACTICE

OF

SHOEING.

BY EDWARD COLEMAN,

PROFESSOR OF THE VETERINARY COLLEGE, PRINCIPAL VETERINARY SURGEON TO THE BRITISH CAVALRY, AND TO HIS MAJESTY'S MOST HONORABLE BOARD OF ORDNANCE, AND HONORARY MEMBER OF THE BOARD OF AGRICULTURE.

VOL. II.

Homo, naturæ miniſter et interpres tantum facit et intelligit, quantum de naturæ ordine, re vel mente obſervaverit; nec amplius ſcit aut poteſt. BACON. NOV. ORGAN.

——Homini quippe, in naturam nullius rei proteſtatem eſſe, præterquam motus, ut ſcilicet corpora naturalia aut admoveat aut amoveat. DE AUG. SCIENT.

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OBSERVATIONS

ON THE

STRUCTURE, ŒCONOMY, AND DISEASES

OF THE

FOOT OF THE HORSE.

AND

ON THE PRINCIPLES AND PRACTICE

OF

BRITISH MUSEUM

INTRODUCTION.

HAVING endeavoured, in a former volume on the Foot of the Horſe, to deſcribe the formation and œconomy of the Cruſt, Horny Sole, Horny Frog, and Horny Bars, I ſhall now proceed to the farther illuſtration of this important ſubject.

The organization and functions of the Foot of the Horſe will be found rather complicated; but it is of considerable importance to thoſe who wiſh to inveſtigate the principles as well as the practice of ſhoeing, to be well acquainted with every part of that organ. The practical part of ſhoeing is often well executed without an accurate knowledge of the

contents of the hoof. But, in many caſes, it is very neceſſary to be well acquainted with the ſtructure and functions of the deeper ſeated parts, and is moſt particularly uſeful for the removal of many diſeaſes incident to the foot. The immenſe weight ſupported by the feet of the Horſe, and the rapidity with which this great animal is conveyed from place to place, without violence to the external or internal parts of the foot, naturally excite a deſire to aſcertain the cauſe of ſo wonderful an effect. If the human foot ſupported the ſame weight as the foot of the Horſe, the ſenſible parts would be deſtroyed. Without ſprings no external covering could effectually ſupport the weight, and prevent the foot from being ſmaſhed. The phyſiologiſt will receive infinite ſatisfaction in the inveſtigation of the functions of this complicated organ; he will find as much order and beauty, as much wiſdom and utility, in

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the formation and œconomy of the foot, as ever was diſplayed in the ſtructure and uſes of any part of any animal. It will be ſeen in many inſtances, that the ſame part performs various functions, and all of theſe functions well. That celebrated anatomiſt, Mr. Hunter, very properly obſerved, that nature had ſeldom been able to make the ſame organ perform two different functions well, and the inſtance he quoted of the leg of the duck being admirably formed for ſwimming, but not for walking, is one proof among others in ſupport of his opinion. The frog of the Horſe, however, and ſeveral other parts of the foot, perform various uſes, and all of them in perfection.

On the utility of plates for the illuſtration of theſe and other particulars, it is unneceſſary to expatiate.

The plates of this work, however, may poſſibly be thought more numerous and more expenſive than was neceſſary; but as the principles and practice of ſhoeing adopted at the College have been founded on a knowledge of the ſtructure and uſes of the parts, and as a proper idea of the internal mechaniſm of the foot cannot be learnt from a mere verbal deſcription of the organ, it was deemed expedient to repreſent all the important parts of the foot. The plates are outlines finiſhed by the hand; and although this mode is much more expenſive than common coloured anatomical plates, yet I truſt that the execution of them will be found equal to the additional expence. The principles of ſhoeing, publiſhed in the firſt volume, have been in many inſtances miſconceived, and the practice miſapplied; I have therefore thought it my duty, at the conclu-

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ſion of the preſent volume, to give ſome farther explanation of the ſyſtem, and I have been the more anxious to enlarge on this ſubject in conſequence of Mr. Moorcroft's publication, whoſe *principles* of ſhoeing are not, in ſeveral particulars, diſſimilar to my own, but from whom I certainly differ widely in practice. If the principles of both are the ſame, and if both are founded in truth, then the practice of one of us at leaſt muſt be wrong. The candour and moderation Mr. Moorcroft has ſhewn in combating opinions at variance with his own, deſerves my thanks. I am alſo ready to acknowledge the high ſenſe I entertain of his talents and profeſſional knowledge; but, the more eminent Mr. Moorcroft's profeſſional character, the more I feel it my duty to ſcrutinize thoſe opinions moſt likely to make an impreſſion on the public mind, and many of thoſe

opinions

opinions, although very plauſible and ingenious, are nevertheleſs, in my humble judgment, founded in error.

The public in general, and regiments of cavalry in particular, have now had ſeveral years of experience to aſcertain the effects of the College ſyſtem of ſhoeing; and ſo far as I have been able to determine from my own experience, added to the information I have received from others, who have ſtrictly adhered to the ſame principles and practice of ſhoeing, I am more and more confident of the truth of my former opinions: That where the cruſt is allowed to project downwards beyond the ſole, and where the heels of the ſhoe are made to reſt on the junction of the bars and cruſt, corns do not take place: that where the hoof is expoſed to

heat,

heat, and the frog without preſſure, the heels and frog will be liable to contraction and thruſhes, and the cruſt to ſand cracks. It is the intereſt and duty of every writer frequently to examine the opinions he has publiſhed, and where the ſubject is of a practical nature, and admits of demonſtration, the public have a right to expect that the author will embrace every opportunity to acknowledge either that the opinions formerly cheriſhed are, from better experience, in part or wholly given up, or that longer and more extenſive practice has confirmed their utility. The great object of every inquirer into nature or art ſhould be Truth, and he who blindly adheres to any ſpecious opinion, merely from its being the offspring of his own brain, or from prejudice, or a miſtaken policy, has not the courage to acknowledge and correct his errors, muſt ſooner or

later

later have the mortification to ſee them expoſed by others: nevertheleſs, I am not ſo vain as to ſuppoſe that no alterations or improvements of any kind can now be made in the practice of ſhoeing—doubtleſs there may be many; but I feel no heſitation in ſaying, that as long as horſes' feet are expoſed to the unnatural heat of the ſtables, the lower ſurface of the frog, in order to preſerve its own health, and indeed the health of the whole foot, ſhould receive preſſure, and that no method of ſhoeing can more effectually guard againſt corns, than the removal of a portion of dead ſole at each time of ſhoeing, ſo as to leave the horny ſole oppoſite the ſhoe *always concave.*

Facts muſt ultimately prevail; and he who oppoſes hypotheſis to experience, theory to practice, or truth to falſhood, may for a time amuſe and deceive

deceive, but only one of two oppoſite ſyſtems can be right. The man who diſcovers the fallacy of his own principles, and has the honeſty and good ſenſe to recant his opinions, and acknowledge his errors, not only ſhields himſelf from cenſure, but deſerves the approbation even of thoſe he has miſled. Under the influence of theſe feelings I truſt I ſhall have full credit in the aſſertion, that the principles and practice of ſhoeing, recommended in the firſt volume, have, from longer experience, fully confirmed my expectations. Several years have now elapſed, during which period many thouſand horſes, within my own knowledge, have been ſhod on the ſame ſyſtem with the very beſt effects. But it is nevertheleſs true, that this practice of ſhoeing has been by many perſons relinquiſhed, either from not being ſufficiently acquainted with the principles

recommended, or with the precautions neceſſary to be attended to in making a conſiderable alteration in any method of ſhoeing. In thoſe inſtances of failure that have come within my own knowledge, where Horſes have been ſuppoſed to be ſhod on the College plan, there has always been a great deviation from the principles recommended. Many gentlemen, who have not paid ſufficient attention to the directions, have erroneouſly ſuppoſed that the College ſhoe was intended for all Horſes of every deſcription, employed for every purpoſe, and with every poſſible kind of foot. But I appeal to all who have done me the honour to attend my Lectures, or ſeen the practice of the College, if the ſyſtem of ſhoeing has not been regulated, not only by the ſhoe previouſly employed, but by the particular form and nature of the foot, and by the length and obliquity

of

of the fetlock joint. If what I have ſaid be at variance with what I have written, it is but fair that the latter ſhould be the teſt; but ſo far from recommending the ſhoe to be always made thin at the heel for all Horſes, I have cautiouſly adviſed different kinds of ſhoes to be uſed for different ſorts of feet. In p. 59 of the firſt volume, I have ſaid, "As the feet of Horſes are ſo variouſly deformed by "bad management, it will be requiſite in ſhoeing "to attend to each particular kind of hoof. If any "form of ſhoe be indiſcriminately employed for all "kinds of feet, it muſt frequently fail of ſucceſs." Again, page 60, "After the hoof has been cut, "and properly prepared, it then becomes requiſite "to apply a ſhoe, and to vary its length, breadth, "and thickneſs at the heels, ſurfaces, &c. according "to the hoof." If it had occurred to my mind that

the veterinary practice of ſhoeing might poſſibly have been miſconceived, or miſrepreſented, I do not know that I could have been more explicit, or more guarded in expreſſing my opinion, or in a more pointed manner forbid the indiſcriminate uſe of thin heeled ſhoes; nevertheleſs it has been a very common error to ſuppoſe, that the whole merits of ſhoeing depended on the form of the ſhoe; and in conſequence of my having given a preference to a ſhoe with thin heels for hoofs of a certain form, when employed for ordinary purpoſes, I have been ſtrangely miſunderſtood to recommend the ſame ſhoe to be employed on all occaſions, and for every kind of hoof. There are only two *principles* to govern the practice of ſhoeing, which for all Horſes, in all ages, and in all countries, muſt be invariably followed. By principles, I mean rules which are to be in all caſes

adhered

adhered to without deviation. In regard to the ſhoe itſelf, I have repeatedly ſaid, that it requires a different form for different Horſes; that as the magnitude of the hoof varies, ſo the ſize of the ſhoe, its ſhape, its breadth, and thickneſs, and weight, muſt be altered by circumſtances. But ſtill there are two rules or principles in ſhoeing to be univerſally adopted, and which are of much greater moment than the ſhape of the ſhoe itſelf. So long as nails and iron are employed to protect the hoof, the cruſt is the part that ſhould receive the nails and the preſſure of the ſhoe; and the ſole of every Horſe employed for every purpoſe is a part that ſhould *not* be in contact with the ſhoe. I mention theſe facts, not as diſcoveries, but to ſhew that although there are ſeveral other general and important rules very neceſſary to be attended to, yet in the practice of ſhoeing

ing there are but two principles, as already obſerved, to be followed in all caſes, viz. That the ſhoe ſhould invariably reſt on the cruſt, and never touch the ſole. All other rules for the practice of ſhoeing are ſubordinate and conditional, and muſt be governed by the weight and action of the animal, by the form of the hoof and fetlock joint, by the form and wear of the ſhoe previouſly applied, and various other circumſtances, which have been before particularized in the former volume. I have obſerved that the frog in many caſes receives great benefit from a thin heeled ſhoe; but yet I thought it neceſſary to add, page 64, that "where the Horſe has been "in the habit of wearing high heeled ſhoes, the "frog would be liable to be bruiſed and inflamed, "and the muſcles that bend the legs, by an impro- "per application of a ſhoe thin at the heels, ſtretched "beyond their tone."

Again, " Whether the ſhoe or hoof be the cauſe " that elevates the frog, the ſame attention is re- " quired to bring it gradually in contact with the " ground;" for although the frog would be improved by the preſſure of the ground, yet in thoſe feet where that object cannot be obtained without improperly lowering the heels, and expoſing the ſenſible ſole to injury, or putting the muſcles of the leg too much on the ſtretch, then, in ſuch caſes, the advantages of preſſure on one organ of the foot, viz. the frog, are overbalanced by the ſudden miſchief and lameneſs of other parts. But as in thoſe caſes where it is not practicable to make the horny frog of the ſame level as the ſhoe, an artificial frog may be applied, it ſhould now be admitted as a general rule, that the frogs of all Horſes, when at reſt, may with advantage receive preſſure; but which, before the

application

application of artificial preſſure, could by no means be commonly effected in the practice of ſhoeing.

Before the application of artificial frogs, it was often impoſſible to give preſſure to the horny frog in the ſtable; but as the frogs of all Horſes, from their elaſticity and convexity, were intended by nature to touch the ground, and to receive preſſure, it is abſolutely neceſſary to their health, and to the œconomy of the whole foot, that the practice of ſhoeing ſhould not deſtroy the original formation, or impede the functions of the frog. Nevertheleſs, although preſſure on the frog be indiſpenſibly requiſite to the health and functions of the foot, yet as no form of ſhoe, while the animal is at reſt on hard and ſmooth pavement, can accompliſh, in all feet, that object, but at the hazard of great miſchief to other parts, it follows,

lows, that without an artificial frog it would ceaſe to be a rule in the practice of ſhoeing, for the frogs of *all* Horſes to have preſſure; that is, if the hoof be expoſed to artificial heat in the ſtable, and the artificial frog not applied, but the heels indiſcriminately lowered, and the frogs without diſtinction, or preparation, brought ſuddenly into contact with the ground, the animal will frequently, from that cauſe, ſuſtain more miſchief, and be more frequently lame, than from a gradual contraction of the hoof, occaſioned by the want of preſſure to the frog.

Having made theſe few preliminary obſervations, for the purpoſe of obviating difficulties, doubts, or miſapprehenſions, I ſhall now examine the ſtructure and functions of the contents of the hoof, on the nature and knowledge of which the principles

and practice of ſhoeing, already deſcribed, have been chiefly founded; and, following the method adopted by the moſt celebrated anatomiſts, I ſhall firſt conſider the bones of the foot, with their ligaments and cartilages.

Secondly, The coverings of the coffin bone, namely, the ſenſible laminæ, ſenſible ſole, ſenſible frog, and ſenſible bars.

Thirdly, The muſcles and tendons, by which the bones are put into motion.

Fourthly, The arteries, veins, nerves, and abſorbents.

I ſhall then reply to the objections made to the practice of ſhoeing adopted at the Veterinary College; and laſtly, conſider how far Mr. Moorcroft's practice is conſiſtent with the principles common to us both.

OBSER-

OBSERVATIONS

ON

THE STRUCTURE AND ŒCONOMY

OF THE

FOOT OF THE HORSE.

SECTION I.

A DESCRIPTION OF THE BONES, LIGAMENTS, AND CARTILAGES, OF THE FOOT OF THE HORSE.

ALTHOUGH there are but three bones contained within the hoof, there are other bones immediately above, which form the paſtern joints, whoſe functions are intimately connected with the foot, and whoſe relative ſituation and proportions, in the management of ſhoeing, are neceſſary to be

attended to; and that the œconomy of the bones within the hoof may be the better underſtood, I ſhall firſt conſider the large paſtern bone. This bone at its upper part contributes to form what is termed the large paſtern joint; it articulates above with the lower head of the cannon bone. The upper head has three concavities; * one in the centre, to receive the middle and narrow convexity of the lower end of the cannon, and two large, but ſuperficial concavities, for the outer and inner convexity of the head of the ſame bone. At the back part of the large paſtern bone there is a rough and concave ſurface † to receive a flat deep-ſeated ligament, which is alſo attached to the lower edge of the two ſmall ſeſamoid bones. The anterior part of the large paſtern bone is ſlightly convex, and the

* See Plate I. 1, 2, 3. † See Plate II. b b b.

upper

upper edge porous, and rather rough, for the attachment of ligament.* The lateral edges of this bone are ſomewhat rounded, and leſs in circumference in the middle than at the two extremities. The lower head of the bone is convex at the outer and inner part, to articulate with the upper head of the ſmall paſtern bone, and ſlightly concave in the centre, to receive a narrow convexity of the ſmall paſtern bone. The two lateral ſurfaces of the lower part of the large paſtern bone are rough, for the inſertion of ligaments; but the lower and anterior ſurface is ſomewhat concave, at which part the extenſor tendon is inſerted. The upper and lower head of the large paſtern bone are covered by cartilage. Between the cartilage covering the lower head of the cannon bone, and the cartilage attached

* See Plate I. 4, 4.

to

to the upper head of the large paſtern bone, there is a quantity of ſynovia, or joint oil, to prevent friction; but the formation and properties of this fluid will be hereafter more particularly deſcribed. The two ſeſamoid bones are placed at the back part of the large paſtern joint.* They are of an irregular wedge-like form, the lower edge of which is oppoſite the poſterior and ſuperior edge of the large paſtern bone. Each of theſe ſmall bones has a ſmooth ſurface covered by cartilage, to articulate with the convex poſterior head of the cannon bone; and the poſterior and middle convexity of the lower head of the cannon bone is received between the two ſeſamoid bones. The poſterior ſurface of the ſeſamoids is ſmooth, and alſo covered by cartilage for the long flexor tendon to ſlide over, and on both ſurfaces of

* See Plate II. a a.

the

the ſeſamoid bones there is a quantity of ſynovia, to prevent that friction, which would otherwiſe enſue from the action of the flexor tendon. The lateral and ſuperior edges of theſe bones are irregular, for the inſertion of a ſtrong ligament connected with the back and ſuperior parts of the cannon, and attached to each ſeſamoid bone ſeparately. This ligament is then continued downward and obliquely forward, to be inſerted into the extenſor tendon, a little below the large paſtern joint. A ſmall portion of the ſuperior ſurface of the ſeſamoid bones is not attached to ligament, but covered by cartilage, and the lower edges of theſe bones are rough, for the attachment of flat ligaments, inſerted into the back part of the large paſtern bone. From the mechaniſm of the large paſtern joint, it appears, that the two ſeſamoid bones perform a very important function.

In

In conſequence of their forming the back part of the large paſtern joint, and articulating with the lower and poſterior part of the cannon; they contribute very eſſentially, by always receding whenever the foot comes in contact with the ground, to act as a ſpring to the animal, and to prevent concuſſion. All the weight received by the upper head of the large paſtern bone is conveyed to bones below; but a conſiderable portion of the burthen is received by the ſeſamoid bones. While the animal is at reſt, and alſo during motion, theſe bones ſuſtain part of the weight, and where the paſtern joints are long and oblique, the ſeſamoids often receive ſo much of the weight as to put the ligaments violently on the ſtretch, and occaſion lameneſs. This effect may alſo enſue, in conſequence of the heels of the hoof being improperly cut down, or the toe allowed to

grow

grow too long, or the heels being firſt raiſed by a high-heeled ſhoe, and then ſuddenly changed for a ſhoe with thin heels. All theſe cauſes, however, whether ſeparate or combined, do not operate with ſo much violence in the hind as the fore legs. The additional weight of the head and neck, to be ſuſtained by the fore legs, renders all their ſprings more liable to injury and decay, than the correſponding parts behind. It is an old eſtabliſhed opinion, that horſes with long and very oblique paſtern joints perform all their functions with great eaſe to the rider, that is, with little ſhake or concuſſion; but then, the horſe is known to be proportionably weak in the paſtern joints, and this weakneſs ariſes in conſequence of the weight of the animal being ſupported more by the ſeſamoids, and leſs by the paſtern bones. Whereas, when the paſ-

tern joints are more upright, the weight is thrown more on the paſtern bones, and leſs on the ſeſamoids; and then the elaſticity is diminiſhed, but the ſtrength increaſed. The paſtern joints, however, are often too upright, and in thoſe caſes the concuſſion is violent, and the paſtern joints become enlarged; and this defect, moreover, ſometimes ends in lameneſs. Theſe facts elucidate the cauſe and intention of large and heavy horſes, generally having ſhort paſtern joints, and blood horſes long and oblique paſtern joints. The one, from his motions being ſlow, and the weight conſiderable, requires more ſtrength than elaſticity: while the blood-horſe, being ſwift in motion, and of little weight, ſtands in need of a greater ſpring; which affords an effectual proviſion to guard againſt concuſſion. There are exceptions to theſe, as to moſt other general

rules;

rules; but, it is as unnatural to ſee a thorough-bred horſe, with upright and ſhort paſtern joints, as it is to obſerve a heavy draught horſe, with thoſe joints long and oblique. It is therefore a wiſe proviſion of nature in creating this difference, in different individuals of the ſame ſpecies. The ſmall paſtern bone is about half the ſize of the large paſtern bone, and at both ends is covered by cartilage. The upper ſurface has two regular concavities, to articulate with the two convex heads of the lower portion of the large paſtern bone, and between the two cavities there is a convex ridge to be received into a correſponding concavity, in the lower head of the large paſtern bone. The ſides of this bone are rough, for the attachment of ligaments. The back part of the ſmall paſtern bone, at the upper part, projects a little to

receive the inſertion of a long ligament* attached above to the lower and poſterior edges of the ſeſamoid bones. This projection of the ſmall paſtern bone receives laterally the inſertion of two ſlips of the ſhort flexor tendon. The lower end of this bone has a larger ſurface for articulation than the upper, and is connected below with two other bones—the navicular and coffin bone. As all the weight of the animal which has been conveyed to the large paſtern bone is received by the ſmall paſtern, it is of importance to inveſtigate in what manner this immenſe quantity of matter is ſupported by the laſt bones of the foot. The foot of the horſe does not occupy more ſpace on the ground than the human foot; but ſo great is the weight to be ſuſtained by the foot of the horſe, that unleſs

* See Plate V. w w.

ſome

ſome extraordinary proviſions were made to guard againſt concuſſion, the hoof and bones would be liable to be bruiſed and fractured at every ſtep. Some of the ſprings which nature has employed to diminiſh the force of ſhocks, have been already noticed. But the ſame grand principle is extended to a much greater degree, and in various ways, within the cavity of the hoof. One method to prevent concuſſion within the hoof, is the articulation of (what has been termed) the coffin joint, that is, the union of the lower head of the ſmall paſtern bone with the navicular and coffin bone. If theſe bones were at once to convey the weight they received to the ground, or to any other hard body, not capable of giving way, then concuſſion or fracture would be likely to enſue. The navicular bone is connected above with the back part of the ſmall paſtern bone,

and

and alſo with the flexor tendon by a flat ligament,* while the whole inferior edge of this bone is attached by a large flat ligament to the back part of the coffin bone. The navicular bone is ſlightly concave, and covered by cartilage within the joint,† to receive the poſterior ſurface of the lower head of the ſmall paſtern bone. The poſterior and upper edge of the navicular bone is rough and thick, for the attachment of the ſuperior ligament. The inferior edge of the navicular bone receives poſteriorly a ſtrong flat ligament from the coffin bone,‡ immediately above the inſertion of the flexor tendon. The lower ſurface of the navicular bone is covered by cartilage, and has a ſmall ridge or projection in the centre, to be received into a correſponding con-

* See Plate IV. fig. 1, f f. and Plate V. T.

† See Plate I. f. ‡ See Plate IV. i i.

cavity

cavity in the long flexor tendon. The navicular bone may be ſaid to form two diſtinct circumſcribed joints: one ſurface of the navicular bone being oppoſed to the flexor tendon, and covered by cartilage,* forming one joint, and the other ſurface alſo covered by cartilage, and oppoſed to the lower head of the ſmall paſtern bone, forming the ſecond joint.† The two ends of the navicular bone ſend off a ſhort ſtrong ligament on each ſide to be attached to the inner ſurface of the cartilages.‡ From the articulation of the coffin joint, the functions of the navicular bone ſeem very evident; all the weight of the animal, ſupported by the ſmall paſtern bone, is conveyed to the coffin and navicular bones. That proportion of the burthen ſupported by the coffin bone will be hereafter explained. The navicular

* See Plate IV. h h. † See Plate I. f. ‡ See Plate IV. J, J.

bone

bone receives a part of the weight, and by its deſcent contributes to prevent concuſſion. Mr. Freeman, who has publiſhed a ſplendid work on the Foot of the Horſe, labours to prove that the whole ſpring of the animal depends on the navicular bone; but he has not obſerved the deſcent and ſpring of the ſmall ſplent bones,* the greater degree

* The ſmall ſplent bones are two in number, and are nearly as long as the cannon bone. They are connected to the cannon bones laterally by elaſtic ligaments, and articulate above with the bones of the knee in the fore extremities, and in the hind extremities with the bones of the hock. At every ſtep of the animal theſe bones receive a part of the ſuperincumbent weight, and not articulating with any bones below; the ligaments that unite them to the cannon bone are put on the ſtretch, and the ſplent bones in the ſame proportion deſcend. Spavins and ſplents are the effects of an inflammation of theſe ligaments. A more particular deſcription of theſe bones would be foreign to our purpoſe, as they are here mentioned chiefly to ſhew their importance as a ſpring to the animal.

of

of motion of the two ſeſamoids, and the greateſt ſpring of all, the elaſtic attachment of the coffin bone to the cruſt, alſo the deſcent and aſcent of the ſenſible frog and horny ſole. The navicular bone, however, certainly aſſiſts to compleat that important intention of guarding the whole frame from violence; for as this bone forms part of the coffin joint, it neceſſarily receives a portion of the ſuperincumbent weight, and from this bone, whenever the hoof comes in contact with the ground, deſcending a little, the motion tends to prevent that ſhake to the animal, which, had the navicular bone been fixed, muſt have taken place. The extent of this action is however limited by the ligament; for, although part of this bone reſts on the tendon, and the tendon on ſubſtances highly elaſtic, and capable of very extenſive motion, yet

the bone can deſcend only in exact proportion to the length of the ligaments. Nevertheleſs, although the elaſtic parts below do not increaſe the deſcent of the navicular bone (that is, though the navicular bone would deſcend in the ſame degree without them) yet the preſſure of this bone, on ſubſtances that are moveable and elaſtic, raiſes the navicular bone, when the foot is off the ground, into its former ſituation, and thus contributes to prevent concuſſion. The preſſure of the navicular on the upper ſurface of the ſenſible frog (whenever the horny frog meets the ground) neceſſarily forces the animal oil, contained within the cells of the ſenſible frog, againſt the inner ſides of the cartilages, and from their action the heels of the hoof are preſerved expanded. As the navicular bone is forced down by the poſterior and lower ſurface of the

ſmall

ſmall paſtern bone, the flexor tendon oppoſite the navicular bone is obliged to deſcend exactly in the ſame proportion; and in ſome horſes with high action, and low heels, and long toes, the flexor muſcles are put ſo much on the ſtretch as to occaſion lameneſs.

As tendons are inelaſtic, and cannot be ſtretched, whenever the navicular bone deſcends, the flexor muſcle attached to the flexor tendon muſt alſo deſcend, and in the ſame proportion elongate. But the weight ſupported by the navicular bones of the hind feet being leſs than the weight ſuſtained by the naviculars of the fore feet, the ſame deſcent will not take place; neither will the organs connected with the poſterior navicular bones be equally liable to diſeaſe. The coffin bone will be found to be different in its formation and uſes from

any other bone in the animal. This bone is the laſt in the foot, and is named the coffin bone from its being concealed or buried within the hoof; it is by ſome called the foot bone. The coffin, or foot bone, at its upper ſurface is ſlightly concave, and covered by cartilage,* and articulates above with the lower and anterior end of the ſmall paſtern bone, and behind with the anterior edge of the navicular bone. The coffin bone is convex before, adapted to the concavity of the cruſt within, and nearly of the ſame form as the hoof without. The anterior and ſuperior part of this bone has a convex projection, and which extends upward above the articulation of the joint, into which the tendon of the extenſor muſcle of the foot is inſerted. The uſes of this proceſs, are, to prevent diſlocation of the anterior and lower part of the ſmall paſtern bone

* See Plate I. g g.

when

when the hoof comes in contact with the ground, and alſo to operate as a lever to aſſiſt the action of the extenſor muſcle. The convex ſurface of the coffin bone, below the anterior proceſs, is extremely porous, for the paſſage of blood-veſſels; and at the lower edge of this bone there are about thirteen large foramina, and which are placed chiefly anteriorly for the tranſmiſſion of the principal arteries from the interior ſubſtance of the coffin bone to the edge and lower ſurface of the ſenſible ſole. Laterally, there are two ſmall depreſſions into which the cartilages are inſerted, and joining to theſe depreſſions there is on each ſide a ſmall proceſs, which are received into correſponding concavities of the cartilages. The heels and quarters of the coffin bone are more porous, and have more foramina, laterally for the tranſmiſſion of arteries than any other part of the bone; but they are much ſmaller

than

than the foramina at the anterior and lower edge of the coffin bone. The heels of the coffin bone are more liable to lateral preſſure than the toe, it was therefore neceſſary to increaſe the number of veſſels at that part, to preſerve a more frequent anaſtamoſis.

The inferior ſurface of the heels of the coffin bone is alſo very porous* for the firm attachment of the ſenſible ſole, and alſo for the free paſſage of arteries; but the remaining portion of the lower ſurface of the coffin bone is generally ſmooth and not porous. In ſome inſtances, however, there are ſeveral very ſmall foramina near the edge, but not in the centre of the coffin bone.

The inferior ſurface of the coffin bone has two unequal concave ſurfaces, of which the anterior is the

* See Plate II. L, L.

largeſt, for the attachment of the greater part of the ſenſible ſole. The poſterior concavity receives the inſertion of the flexor tendon, but the heels of the coffin bone extend conſiderably behind the inſertion of the flexor tendon; and when the animal performs quick motion, as in the gallop, or trot, the heels of the coffin bone deſcend ſtill farther obliquely backward and downward, immediately oppoſite the ſeat of corn between the bar and cruſt. At the ſides of the poſterior concavity there are two ſmall lateral depreſſions, each ending in a foramen. Theſe depreſſions receive the two principle arteries of the foot, which are continued through the coffin bone, and the upper edge of the poſterior concavity projects a little, in order to articulate with the navicular bone. The coffin bone has three pairs of ligaments and one ſingle ligament.

The

The firſt pair of ligaments take their origin from the heels of the coffin bone on each ſide,* and paſs obliquely upward as high as the middle, to which they are attached, and at which part of the ſmall paſtern bone they are blended with the fibres of the lateral ligaments of the ſmall paſtern joint. The ſecond pair of ligaments on each ſide ariſe from the edge of the coffin bone, near the heels, and paſs obliquely forward to be inſerted laterally into the middle of the ſmall paſtern bone, contiguous to the attachment of the extenſor tendon. The third pair take their origin from the lateral edges of the anterior proceſs of the coffin bone,† and are inſerted into the edges of the cartilages. The uſe of theſe ligaments is to unite the cartilages more firmly to the coffin bone. The extenſor tendon being inſerted into the upper edge of the anterior

* See Plate III. G.

† See Plate VII. D.

proceſs of the coffin bone prevents the neceſſity of a ligament at this part. The ſingle ligament of the coffin bone* is connected with the poſterior and inferior concave ſurface of the coffin bone, immediately above the inſertion of the flexor tendon, and alſo with the inferior edge of the navicular bone. This ligament unites the navicular bone firmly with the coffin bone; but in order that it may ſupport a larger portion of the ſuperincumbent weight, which it receives from the poſterior and lower head of the ſmall paſtern bone, there is another ligament attached to the whole ſuperior and poſterior edge of the navicular bone.† This ligament is inſerted about a quarter of an inch above, into the back part of the large flexor tendon; and a little above this inſertion there is another ligament ſent off, to be attached to the middle and

* See Plate II. 3, 3, 3. † See Plate IV. fig 1. g g.

back part of the ſmall paſtern bone.* From the attachment of theſe ligaments, it appears that the flexor tendon plays over the navicular bone; which, being alſo covered by cartilage, and ſurrounded by ligaments, a compleat cavity is formed between the lower ſurface of the cartilage covering the navicular bone, and the upper ſurface of the flexor tendon.

The cavity being circumſcribed, and a fluid ſecreted to lubricate the action of the tendon, any laceration of the tendon oppoſite the poſterior ſurface of the navicular bone would produce all the conſequences of an expoſed joint. The ſynovia between the tendon and poſterior ſurface of the navicular bone would eſcape, and as the tendon, in that caſe, muſt at every motion be in contact with the

* See Plate IV. f, f.

navicular

navicular bone, friction and inflammation would enſue. Whereas in health, although the tendon paſſes over the cartilage of the navicular bone, yet there being a fluid between the tendon and cartilage, they never touch each other; and as there is little friction between a ſolid and a fluid, the tendon performs its motion without any obſtruction. The navicular and coffin bones united, being the laſt bones of the extremity, receive the whole burthen conveyed to the ſmall paſtern bone. At every ſtep the poſterior and inferior part of the ſmall paſtern reſts on the navicular bone, and at every ſtep this bone deſcends on the flexor tendon and ſenſible frog.

It has been, however, already remarked, that the deſcent of the navicular will not be in proportion to the elaſticity of the ſenſible frog below,

but to the extent of the ligaments of the navicular bone; for, if in the place of the ſenſible frog there had been a cavity, and no reſiſtance of any kind below, the motion of the navicular bone, from the ſtructure of its ligaments, would have been equally limited.

If the heels are very low, and the fetlock joint oblique, the navicular bone will be placed more immediately under the centre of the limb, and then the preſſure of the ſmall paſtern bone will be more on the navicular, and leſs on the coffin bone; and as that bone is chiefly ſupported by ligaments, they are liable, by the heels being improperly lowered, or the fetlock joint too long, to become injured. Moreover, as the flexor tendon neceſſarily accompanies the navicular bone at every ſtep, in violent exertions the navicular bone is ſometimes

times forced down with ſo much force as in part to ſeparate above the fetlock joint the long flexor tendon from the ſhort flexor.* The long flexor tendon, at the back part of the cannon bone, is united by looſe cellular membrane to the ſhort flexor tendon, which membrane will admit of a certain degree of motion without miſchief to the union that ſubſiſts between the two tendons. But where the paſtern joint is long, the heels low, or violent exertion uſed, or where, from any cauſe, the navicular bone and long flexor tendon are preſſed down with extraordinary force, this unnatural action tends more or leſs to ſeparate the tendons. From the hoof to the fetlock joint there is a natural ſeparation of the tendons, and a fluid between them, and

* Theſe parts will be deſcribed more particularly when the muſcles are conſidered; but as their function is intimately blended with the deſcent of the navicular bone, it was thought neceſſary to mention them in this place.

therefore any ſwelling or injury to this part is very uncommon; but any inflammation or tumor is ſufficiently manifeſt above the fetlock joint, where both tendons are united. This diſeaſe is ſometimes termed a clap or ſtrain in the back ſinew; but it would be improper in this place to dwell on the nature and treatment of diſeaſes, although it ſeemed neceſſary here to mention the cauſe of the malady, while the œconomy of the parts concerned were under conſideration. As the long flexor tendon paſſes over the navicular bone, it is evident that the bone without the tendon cannot deſcend. Whenever the navicular bone receives ſo much of the weight of the animal as to deſcend preternaturally, the ligaments of the bone muſt be injured, and the long flexor muſcle and tendon will bear more than their due proportion of the weight.

weight. That miſchief either about the ligaments of the navicular bone, or the union between the tendons ſhould enſue, is therefore a matter that is neither inexplicable nor indeed extraordinary; but the ſhort flexor tendon having no direct connection with the navicular bone, will be leſs affected by the motions of that bone. It has been obſerved by ſome writers, that that portion of the flexor tendon which is immediately oppoſite to, and paſſing over the lower ſurface of the navicular bone, in conſequence of the deſcent of that bone, is often bruiſed and inflamed. But the flexor tendon, and navicular bone, at this part are protected from injury, not only by a cartilaginous covering, but by the intervention of a fluid between the tendon and navicular bone; beſides, the lower ſurface of the flexor tendon reſts on a very elaſtic ſubſtance, the ſenſible

frog,

frog,* which is capable of giving way to a much greater extent than the ligaments can elongate or the navicular deſcend. No part, therefore, can be better preſerved from injury; one ſurface of the tendon being oppoſite to, and in contact with a fluid, and the other ſurface reſting on a bed of oil contained in cells, ſo that in truth the navicular bone, in health, never touches the tendon. The ligaments of the navicular and coffin bone perform the ſame functions as ligaments of all other joints; that of preventing diſlocation, allowing the joints a certain degree of motion, and confining the joint oil. This oil is of great importance to the motions of the animal, and has been generally ſuppoſed to be formed from a part which has been termed ſynovial gland. But the anatomiſts of the preſent

† See Plate V. N, N, N, and S.

day

day have aſcertained that this ſubſtance is only a quantity of adeps, and cannot perform ſecretion. Farther on this point, many of the ſmaller joints have no ſuch ſubſtance, and yet all joints in health have ſynovia: a clear demonſtration, that the exiſtence of this ſuppoſed gland is not neceſſary to the formation of ſynovia. The ends of all bones are covered by cartilages or griſtle, and theſe cartilages are covered by a vaſcular membrane, which lines the inner ſurface of the ligaments of all joints. It is this membrane which pours from the mouths of the blood veſſels a quantity of oily matter to lubricate the parts; and there is probably no part of this vaſcular ſurface that does not ſecrete more or leſs of the ſynovia. The uſes of this oil are ſo eſſential to the œconomy of joints, that if it eſcapes,

in conſequence of a wound, or any other accident, without being ſpeedily cloſed, death often enſues. The oil being placed within a circumſcribed cavity, and that cavity being compleatly filled, the bones are never in contact; and this prevents that friction which otherwiſe would neceſſarily take place between the ends of bones. The cartilages covering the ends of bones in part contributes to guard againſt concuſſion; but from the conſtant preſence of the oil, which cannot without a wound eſcape, the ſolid parts of the joint never touch each other. The mechaniſm of different joints varies conſiderably in many important particulars; but in all caſes where there are ligaments to form a joint, there is always a quantity of ſynovia to prevent the contact of ſolid bodies.

When

When the immenſe weight ſupported by the legs of the horſe, and the rapidity with which he moves from place to place is duly conſidered, it is manifeſt that great miſchief muſt have taken place, if both oil and cartilages had not been interpoſed between the ends of bones. Any machine, merely turning on its own axis, requires a ſupply of oil; but the legs of a horſe are raiſed high above the ground at every ſtep, and would be fractured without a conſtant ſupply of ſynovia, and a great variety of ſprings, ſome of which have been already mentioned, and other ſprings will be hereafter pointed out.

The ſmall paſtern joint is ſecured in part by the attachment of the ſheath of the tendon, and in part

by the long ſeſamoid ligament. The ligament and tendon encloſe the whole back part of the ſmall paſtern joint, but the long ſeſamoid ligament is attached poſteriorly to the centre of the ſmall paſtern bone, while the ſheath of the tendon divides into two lateral portions. This ſinew, from its inſertion, performs the function of a ligament, and renders a ſeparate ligament at this part unneceſſary. In like manner the anterior part of the ſmall paſtern joint is ſecured by the firm attachment of the extenſor tendon to the lower head of the large paſtern, and upper head of the ſmall paſtern bone.* As ſimplicity is a great object in mechanics, ſo in nature we find, that although every thing is made completely to anſwer its purpoſe, yet nothing ſuperfluous is added. Where tendons can anſwer the intentions of liga-

* See Plate III. c c.

ment, without altering their courſe, and where additional ſtrength is not wanted, tendons occaſionally ſupply the neceſſity of ligament. The ſtructure of tendons, like the ligaments of joints, is inelaſtic. The long ſeſamoid ligament, inſerted into the back and upper part of the ſmall paſtern bone, takes its origin from the lower edge of the two ſeſamoid bones. This ligament does not adhere to, but extends conſiderably behind the large paſtern bone, cloſe to the long flexor tendon; and it becomes narrower as it deſcends, until it approaches the lower head of the large paſtern joint; at which part it expands, and being continued within the ſheath of the tendon, paſſes over the ſmall paſtern joint, and is finally inſerted into the centre of the poſterior and ſuperior part of the ſmall paſtern bone.* Immediately under the upper part

* See Plate IV. B, B, B. and Plate V. W, W.

of

of the laſt ligament is a deeper ſeated ſeſamoid ligament, which takes its origin from the lower and inner edge of the two ſeſamoids, and cloſely adheres to the back part of the large paſtern bone.* Theſe two ligaments unite the two ſeſamoid bones with the upper and back part of the large paſtern bone, and confine the lower ends of theſe bones in their proper ſituation. The ſeſamoid bones are alſo confined above by ligamentous attachment.† The ſuperior end of this ligament takes its origin from the middle of the upper and back part of the large metacarpal or cannon bone; ſome of the fibres of which extend as high up as the ligaments of the ſmall bones of the hock and knee joint. This ligament, about one inch above the ſeſamoid bones, divides into two diſtinct parts, which are attached to the whole upper portion, and alſo to the

* See Plate V. U. † See Plate V. V.

outer

outer and inner edges of the ſeſamoids, and are then continued obliquely forward and downward over the anterior part of the large paſtern bone, to be united to the extenſor tendon.* In ſtructure this ligament above the ſeſamoid bones is different from common ligaments. On cutting through the centre ſome of the fibres appear of a red muſcular ſtructure, and the ligamentous fibres are ſomewhat elaſtic. It is however probable, that the muſcular fibres are intended merely to ſtrengthen the ligamentous fibres in their function. This elaſtic ligament confines the upper part of the ſeſamoid bones, and at every ſtep, when the foot meets the ground, ſupports the ſeſamoids, and enables them to receive the poſterior and inferior part of the cannon. The weight which the ſeſamoids, by the aid of this

* See Plate III. d, d, d.

ligament,

ligament, ſuſtain, is very different in different horſes; and bears no exact proportion to the bulk and weight of the animal. The paſtern joints of large horſes, as before obſerved, deſtined for ſlow motion, are wiſely conſtructed very differently from thoſe of blood-horſes. Their paſtern bones are ſhort, and the joints nearly ſtraight; but thorough-bred horſes of light weight have long and very oblique paſtern joints; and, as in proportion to the obliquity of the large paſtern or fetlock joint, the cannon conveys more of the weight to the ſeſamoid bones; the ligaments that ſupport the ſeſamoids are neceſſarily put more into motion, and more on the ſtretch, as the weight preſſes down the lower and back part of the cannon on the ſeſamoid bones. Short paſtern joints are as much adapted to the frame of heavy horſes

as

as longer joints are to that of lighter horſes. The ligaments that ſupport the ſeſamoids above, for the purpoſe of motion and elaſticity, alſo contribute to aſſiſt the flexor muſcles and tendons in preſerving, when at reſt and in motion, the large paſtern joint in its proper place. But it is probable that this ligament, although poſſeſſing ſome few muſcular fibres, is not ſubject in the ſame degree as muſcles, to exhauſtion from fatigue.

In order to aſcertain more accurately the functions of this ligament, I divided it with a knife above the fetlock joint. The ſeſamoid bones in this caſe having no other ſupport above, than the flexor tendons, were brought nearly in contact with the ground. From this experiment it appears, that the ſuſpenſory ligament, when the animal is ſtanding,

chiefly ſupports the paſtern joint, and probably a conſiderable portion of the weight of the animal. The upper part of the large paſtern bone is connected with a long extenſor ligament.* This ligament takes its origin from the outer ſurface of the ligaments of the knee joint, and immediately below receives the inſertion of an extenſor tendon. It is then continued obliquely over the cannon bone, and at laſt inſerted into the anterior head of the large paſtern bone, on the outer ſide of the extenſor tendon. This ligament ſtrengthens the fetlock joints of the fore legs, but in the hind leg this ligament is wanting. There are two lateral ligaments both in the fore and hind extremities: theſe ligaments are attached to the upper and lateral parts of the large paſtern bone, and inſerted laterally into the lower head of the cannon bone.

* See Plate III. B.

Thus far then it would appear, that from the fetlock joint downward there are two ſeſamoid bones, the large paſtern bone, the ſmall paſtern bone, and the navicular and coffin bone; that theſe bones are confined together by ligaments, and that, in order to guard againſt friction, the ends of the bones are not only covered by cartilage or griſtle; but that between the cartilage covering the ends of the bones there is a quantity of ſynovia, or joint oil, to prevent friction. Cartilage is alſo placed in various parts of the body for other purpoſes, as in the noſe and ears, the ends of the ribs, &c. Cartilage is light, and yet ſufficienly ſtrong to ſupport its natural figure, and in ſome parts of the body the cartilages receive the inſertion of muſcles for motion. If bone had been in all places ſubſtituted for cartilage, the weight would have been

an additional burthen to the muſcles, and liable to fracture.

The cartilages of the foot of the horſe are not exactly ſimilar, either in ſtructure or œconomy, to cartilages of other animals, or to other cartilaginous parts of the ſame animal. They are four in number, two lateral,* and two inferior cartilages.† The lateral cartilages are ſituated one on each ſide, at the upper and lateral edges of the coffin bone, and extend above the coronet. The upper edges of theſe cartilages project about half an inch above the cruſt, and at this part are merely covered by the common integuments.‡ The lower edges of the lateral cartilages anteriorly are received into a ſmall

* See Plate VII. and 8. † See Plate IX. J, J.

‡ See Plate VII. A, A, A.

depreſſion

depreſſion in, and firmly united with the coffin bone, but the upper edges extend as high as the ſmall paſtern joint, and are united by ſtrong cellular membrane to the ſides of the ſmall paſtern bone. The poſterior half of the ſide cartilages is ſituated behind the coffin bone,* and continued to the heels of the ſenſible frog; but the lower edge of the cartilages having quitted the coffin bone poſteriorly, forms a ſlight curvature to meet the inferior cartilages to which they are firmly united.† The inferior cartilages are attached above to the lower ſurface of the broad inſertion of the long flexor tendon, on each ſide of the ſenſible frog, and connected laterally with the lower edges of the ſide cartilages. The upper part of the heels of the ſen-

* See Plate VII, and VIII.

† See Plate IX. M, M.

ſible

ſible frog are received between, and in union with the heels of the lateral cartilages; while the inferior cartilages are united to the lateral edges of the ſenſible frog.*

The inferior cartilages are leſs elaſtic than the ſide cartilages; they are convex on their upper ſurface, and covered by a quantity of cellular and adipoſe membrane; but the under ſurface of the inferior cartilages is of a concave form, and covered by the ſenſible ſole and bars. Theſe cartilages, from their arch-like figure, independently of their ſtructure, tend to increaſe their ſtrength, and diminiſh their elaſticity. As the navicular bone, contiguous to the flexor tendon at its inſertion into the coffin bone is longer, than the width of the centre of the

* See Plate IX. k, k, k.

ſenſible

ſenſible frog, the lower ſurface of the tendon, not covered by the frog, is attached to the upper convex ſurface of the inferior cartilages by a conſiderable quantity of adipoſe and elaſtic membrane. The navicular bone, therefore, reſts on the flexor tendon; the flexor tendon in part on the ſenſible frog, and in part on the upper ſurface of the inferior cartilages: while the lower and ſmooth ſurface of theſe cartilages is united to the upper ſurface of a part of the ſenſible ſole, and the whole of the ſenſible bars.

I have already endeavoured to prove the deſcent of the navicular bone at every ſtep of the animal; but as the horny ſole immediately oppoſite is naturally arched, that is, convex within, and concave without; it is not probable that the horny ſole, *at this part*,

can

can undergo much, if any change of ſituation. If then the navicular bone and flexor tendon did not reſt on a bed of oil, the tendon and bone would be liable to injury, and the elaſtic functions of theſe parts defeated. But the centre of the navicular bone being placed on the centre of the flexor tendon, and the centre of the tendon being placed on the centre of the upper ſurface of the ſenſible frog,* and the two lateral portions of the navicular bone and tendons being ſupported by the ſame kind of elaſtic ſubſtance, a great degree of motion may be produced in theſe parts, without any deſcent of the horny ſole.

On the upper ſurface of the inferior cartilages the navicular bone can therefore deſcend, equal to the extent of its ligaments, without the ſmalleſt de-

* See Plate V. N, N, N.

ſcent

ſcent of the oppoſite portion of inſenſible ſole, or inſenſible frog. The lower ſurface of the coffin bone is only covered by the ſenſible and horny ſole, and has no adipoſe or elaſtic ſubſtance to yield to preſſure.* Whatever, therefore, may be the degree of motion in the coffin bone, the horny ſole oppoſite muſt always deſcend in the ſame proportion; but the deſcent of the coffin bone will be better explained when the elaſtic laminæ are conſidered.

The ſide cartilages have a number of holes for the paſſage of blood-veſſels, and their inner ſurface is covered with cellular and adipoſe membrane.† All that portion of the external ſurface of the ſide

* See Plate VIII. The ſenſible ſole raiſed from the coffin bone.

† See Plate III. K, K, K.

cartilages, which is ſituated above the hoof, is covered by common ſkin.* Below the coronary ring of the hoof, the cartilages on their outer ſurface, are covered by laminæ,† and the cartilages between the termination of ſkin and the origin of laminæ, are ſurrounded by a coronary ligament,‡ and this ligament is covered by a glandular ſurface, which ſecretes the ſmooth cruſt. The external ſurface of the ſide cartilages is therefore covered by three diſtinct ſubſtances very different in ſtructure, viz. ſkin at the upper part, coronary ligament in the middle, and laminæ below.

The union of the ſenſible frog with the horny frog, and the connexion that is formed between

* See Plate VII. A, A, A. † See Plate VII. C, C, C.

‡ See Plate VII. B, B, B.

the

the ſides of the ſenſible frog and the lower cartilages, moſt effectually prevent diſlocation.* All theſe parts, when the horny frog touches the ground, are put into motion. The horny and ſenſible frogs *aſcend*; but when the horny frog, from ſhoeing or any other cauſe, is free from preſſure, the actions and functions of the frogs and cartilages are ſuſpended.

The ſuperior part of the ſenſible frog being received between the two ſide cartilages, in proportion as the horny frog receives preſſure, the cartilages, when in health, expand or recede from each other; but when the cartilages from oſſification, contraction of the hoof, or any other cauſe, are deprived of motion, the upper part of

* See Plate IX.

the ſenſible frog is confined between two fixed points: whereas, in the natural ſtate, when the horny frog meets the ground, the ſuperior portion of the ſenſible frog aſcends between the ſide cartilages,* and the wedge-like form of that organ neceſſarily opens the heels of the ſide cartilages. The expanſion of the ſide cartilages at every aſcent of the horny and ſenſible frogs, not only gives a powerful ſpring to the animal, and enables the frogs to complete their function, but the direction of the growth of the cruſt at the quarters and heels, is abſolutely governed by the motion of the ſide cartilages.

If the horny frog has no preſſure, the cartilages are at reſt, and the heat of the ſtable evaporates the

* See Plate IX.

moiſture

moiſture of the cruſt, and contracts the quarters and heels of the hoof. Heat produces the ſame effect on the living hoof, as on every kind of dead or living horn: catgut, leather, hair, and I believe all animal ſubſtances are alſo diminiſhed by heat. When the water is evaporated, the ſolid parts contract; but the cruſt at the anterior part is preſerved from any conſiderable contraction, in conſequence of being oppoſed by the coffin bone;* but the upper part of the quarters, and the heels of the hoof, being placed oppoſite to cartilage,† a ſubſtance naturally elaſtic, and incapable of much reſiſtance, the overbearing contraction of the cruſt preſſes the cartilages towards each other, and narrows the heels. So long as the frog uniformly touches the ground, this effect will not take place; for the wedge-like

* See Plate VII. E, E, E. † See Plate VII. A, A, A.

form

form of that organ being preſſed upwards between the cartilages, prevents the new cruſt at the quarters of the cornet from contraction. The weight and action of the animal forcing the frogs obliquely upward, laterally expands the ſide cartilages;* and it is this expanſion at the heels which puts the ſoft newly formed cruſt on the ſtretch, and directs its future growth obliquely outward. The cruſt at its origin, immediately below the hair, is very thin,† and of a ſoft elaſtic nature; and, at the quarters and heels, is always governed in its growth downward by the natural expanſion, or by the morbid contraction of the cartilages.

When the frog is raiſed above the ground (as in common ſhoeing), neither the horny or ſenſible

* See Plate V. 3. † See Plate V.

frog

frog can aſcend, and the ſide cartilages are alſo deprived of motion and expanſion; for, as theſe cartilages are made to recede from each other, ſolely in conſequence of the preſſure of the ground on, and aſcent of the horny frog, ſo the cartilages, when the frog has no preſſure, muſt remain inactive. The functions therefore of the cartilages depend on the functions of the frog; and the ſhoe that deprives the horny frog of preſſure, deprives, at the ſame time, the ſenſible frog and cartilages of their action and uſes. The convex ſurface of the coffin bone is covered with a very elaſtic ſubſtance, which is not ſmooth, but laminated, very ſimilar to the lower part of a muſhroom.* Theſe laminæ are firmly attached to the perioſteum covering the coffin bone, and to the ſtrong coronary ligament that ſur-

* See Plate X. B, B, B.

rounds

rounds the coffin joint;* and alſo to the external ſurface of the two ſide cartilages;† and, laſtly, to the lower edge of the ſenſible ſole.

In a moderate ſized foot theſe elaſtic laminæ are about five hundred in number, and are received between correſponding horny, elaſtic laminæ, or leaves lining the cruſt.‡ The laminæ of the coffin bone and cartilages are ſenſible, and very abundantly ſupplied with blood veſſels: they have been ſuppoſed to be merely an extenſion of the true ſkin; but this ſeems improbable, as the ſkin immediately above the hoof is ſmooth, and the extent of ſurface at this part is by no means equal in magnitude to the laminæ. Moreover, the laminæ, at the upper part or apex of the coffin bone, are ſmaller and thinner than

* See Plate X. A, A, A. † See Plate VII. ‡ See Plate X.

the

the laminæ below: but if the laminæ were formed from an elongation and ſtretching of the ſkin, beginning at the apex of the foot, there would be neceſſarily more ſubſtance at this part, than where expanded over the broad diameter of the coffin bone; whereas the laminæ are broader and thicker as they approach the lower edge of that bone. It therefore ſeems more than probable, that the ſenſible laminæ are totally diſtinct from the ſkin. At the lower and poſterior extremity of the heels, the laminæ form a conſiderable angle; and, at the bottom of the foot, are attached to the inferior and poſterior extremity of the ſenſible ſole.* The foraminæ in the lower edge of the coffin bone are for the tranſmiſſion of blood veſſels to the ſenſible ſole; but the holes above the edge of this bone are to

* See Plate VIII. h.

convey blood veſſels to and from the ſenſible laminæ. The ſenſible laminæ ſecrete the inſenſible horny laminæ lining the inſide of the cruſt; and, at every part of the ſenſible laminæ, the mouths of the arteries pour forth more or leſs of that elaſtic horn. On this myſterious and inexplicable proceſs called ſecretion I do not mean to enlarge; it is ſufficient in this place to ſtate, that there is a power in the extremities of arteries to convert blood into a great variety of ſolids and fluids: and yet that the blood, circulating throughout the whole animal, does not appear to poſſeſs different qualities in different arteries.

The moſt experienced and beſt informed chymiſts and anatomiſts have not been able to diſcover any ſpecific difference between the blood ſent to the ſkin,

to the teſticle, or to the foot; and yet the blood diſtributed to the ſkin will produce hair and perſpiration; to the kidney, urine; to the teſticle, ſemen; to the foot, horn. In like manner the blood diſtributed to the outer ſurface of the coronary ligament, above the laminæ, is, in part, converted by the mouths of the blood veſſels into ſmooth cruſt or wall, while the blood ſent to the ſenſible laminæ, and ſenſible frog, produce the horny laminæ and the horny frog. Theſe ſubſtances are all horn; but, nevertheleſs, the form, ſtructure, and œconomy of theſe parts are very different, although the original material, that is, the blood, from which all theſe ſubſtances are formed, is alike.

The ſenſible laminæ conſtantly produce freſh horn during the whole life of the animal: the ſides of

the horny laminæ daily deſcending between the ſides of the ſenſible laminæ; the latter always remaining ſtationary, while the horny laminæ are perpetually ſhifting their ſtation. When the horny laminæ have deſcended as far down as the edge of the ſenſible ſole, the perpendicular cavities, between the horny laminæ, are filled up with horny matter, ſecreted and depoſited by the arteries at the very edge of the ſenſible ſole. The lower edge of the cruſt therefore, below and oppoſite the edge of the horny ſole, in conſequence of all the interſtices being filled up by horny ſole, is not laminated; and it is this depoſition of horn that ſo cloſely unites the edge of the horny ſole with the cruſt. As each of the ſenſible laminæ have two lateral ſurfaces, and alſo an edge, that is, three diſtinct attachments, to three correſponding ſurfaces of horn of equal magnitude; the union be-

tween the coffin bone and cruſt becomes ſo extenſive and ſo ſtrong, as to be equal to ſupport the ſuperincumbent weight of the animal.

This fact has been already mentioned in my firſt volume on the Principles and Practice of Shoeing. It is there obſerved, that if the ſole, frog, and bars, be removed, or become ſoft and incapable of reſiſtance, as in canker; ſtill the attachment of the laminæ of the coffin bone to the laminæ of the cruſt, is capable of ſuſtaining the whole weight of the animal.

It has been commonly ſuppoſed, that the horny ſole chiefly ſupported this weight; but if the animal was, in reality, ſupported by the bottom of the hoof, and if that ſupport be removed, then the foot muſt

neceſſarily

neceſſarily ſlip through the cruſt. It has been ſaid, in anſwer to this opinion, that theſe obſervations may lead the young practitioner into ſerious errors; and without a ſingle experiment, or one fact, to controvert my opinion, the writer ſays, " To us it ſeems, " from the ſituation of the ſole and frog, their " form, ſtrength, and intimate connection with, and " exact application in their whole extent to the " parts above them, that they muſt receive a great " part of the weight of the animal; and that if it " be a fact, that the ſole and frog do not ſupport a " great part of the weight of a horſe, it muſt follow, " that the foot bones would not ſlip through the " cruſt, if the frogs and ſoles of all the feet were " taken away at the ſame time: but we will ven- " ture to aſſert, that ſhould any one make the ex- " periment, the reſult would convince him of the

" falſity

" falſity of the author's (Mr. Coleman's) aſſertion." It is my duty to anſwer theſe obſervations. I am well ſatisfied, that the functions of the ſenſible and horny laminæ, or of any other organ, without experiment, cannot be perfectly aſcertained; and the writer has pointed out the teſt whereby the fact can be demonſtrated, viz. that of removing the horny ſoles, frogs, and bars, of all the feet.

It is natural to infer, that the author had actually made this experiment, and found the reſult to favour his own conclusions; and as, in the mode of making the experiment, we perfectly agree, the fact can be easily aſcertained. I can ſpeak to this point, not from hypothesis, not from prejudice to any particular theory, not from report, but from numerous facts. I have ſeen many

horſes

horſes with canker in all their feet, that is, with the lower part of the foot ſoft, without horny frogs, horny ſoles, or horny bars, and yet with no diſpoſition in the coffin bone of either foot to ſeparate and deſcend from the cruſt; and the following experiment ſeems to prove, that the bond of union is much more than equal to ſupport the weight of the animal.

EXPERIMENT.

The ſoles, bars, and frogs, had been taken away from both the fore feet of a horſe: I ſaw the animal a few minutes after the operation, and he was trotted ſeveral yards without any alteration in the ſituation of the foot or coffin bone. To encreaſe the weight of the animal on the laminæ of the fore

feet,

feet, the off and near fore foot were alternately taken off the ground for ſeveral minutes, and the coffin bones were afterwards found in the ſame ſituation as before. It alſo happened, that on placing the hand on the loins of this horſe, he kicked with great violence, and repeated his ſtroke ſeveral times. Now, during the period his hind legs were in the air, all the weight of the animal was ſuſtained by the laminæ of two feet, and yet this extraordinary weight made not the ſmalleſt change in the ſituation of the foot bones.

From this experiment, therefore, it appears that the union of the ſenſible laminæ with the horny laminæ, is ſufficiently ſtrong to ſupport the whole weight of the animal on two feet; for although the navicular bone receives part of the weight from the

ſmall paſtern bone, yet, as the navicular is joined to the coffin bone by ligaments, the laminæ indirectly, ſuſtain the navicular bone alſo.

The horny ſole, frog, and bars, have their reſpective functions, and their uſes are highly important; but they do not perform the function commonly aſcribed to them, that of ſupporting the weight of the animal: indeed, nine-tenths at leaſt of the ſenſible and horny frog are placed behind the coffin bone, and therefore cannot ſupport any conſiderable part of the weight. The laminæ being about five hundred in number, at every ſtep act as ſo many elaſtic ſprings; and the navicular bone receiving part of the weight from the ſmall paſtern bone, and not articulating with any bone below, at the ſame inſtant that the laminæ elongate, the

navicular

navicular bone deſcends, and this motion of the navicular aſſiſts the laminæ to prevent concuſſion. As the ſmall paſtern bone imparts all its ſuperincumbent weight to the coffin and navicular bone, the horny ſole, the horny bars, and the toe of the horny frog, would now receive the burthen, if the laminæ of the coffin bone were not firmly united to the laminæ on the inſide of the cruſt. But although the weight be ſuſtained by the laminæ, yet theſe ſubſtances, in conſequence of their elaſtic ſtructure, muſt in ſome degree give way, whenever the lower edge of the cruſt meets the ground. This elongation of the laminæ is, indeed, one great excellence of that wonderful piece of mechaniſm; for, if the ſame extent of ſurface, and the ſame degree of ſtrength of union, had been formed of bone, or any other inelaſtic ſubſtance, concuſſion or fracture would pro-

bably have followed. Without motion there can be no ſpring; and as both the horny and ſenſible laminæ are elaſtic in their ſtructure, there can ſcarcely be a doubt, but that the laminæ, whenever the ſmall paſtern conveys the weight to the coffin bone, are always put on the ſtretch, and elongate. This action of the laminæ will be more or leſs in proportion to the action and weight of the animal, and as the legs are raiſed more or leſs high above the ground. But as the fore legs ſupport the head and neck, as well as one half of the carcaſe, the laminæ of the fore feet ſuſtain a much greater weight than the laminæ of the hind feet, and conſequently are put more on the ſtretch. While either of the feet are off the ground, the laminæ, during that period, are at reſt; but even in that ſtate the ſenſible ſole, covering the lower ſurface of the coffin bone, is in cloſe

contact

contact and firm union with the upper ſurface of the horny ſole. When the foot is placed on the ground, the laminæ are put on the ſtretch; and, to act as a ſpring, they muſt in ſome degree elongate. The laminæ, however, unleſs the horny ſole at the ſame time deſcends, cannot elongate; for, if the horny ſole was a fixed point, or made of inelaſtic materials, ſo as not to yield to the preſſure of the weight on the coffin bone, then the laminæ could not be ſtretched or put into motion. However elaſtic the laminæ, the coffin bone and ſenſible ſole would be reſiſted in their deſcent by the inelaſtic ſole, and as firmly fixed as if the laminæ had been made of bone, or any other inelaſtic ſubſtance. In order that the functions of theſe elaſtic organs ſhould be duly performed, it muſt follow, that the coffin bone, the ſenſible ſole, and horny ſole, ſhouldd eſcend in the ſame

proportion

proportion as the laminæ elongate. That the coffin bone ſhould be connected with the cruſt by ſubſtances highly elaſtic, and yet that their functions ſhould be prevented by the permanent fixture of the horny ſole, is not conſiſtent with the wiſdom of nature, or the laws of the animal œconomy. From the ſituation and ſtructure of theſe parts, therefore, it appears, that the laminæ being elaſtic, were intended to move; and, from their elongation, to allow the coffin bone to preſs down the horny ſole, and ultimately, by the combined action of theſe parts, to prevent concuſſion of the whole animal, and of the foot in particular.

The deſcent of the horny ſole is rendered ſtill more evident, by a fact very generally known to almoſt every farrier, namely, that the horny ſole, without

out lameneſs, cannot bear the preſſure of the ſhoe. But the horny ſole has no more feeling than the cruſt or bars, and, conſequently, if the ſole had been fixed, it might, without pain or inconvenience, have received the preſſure of the ſhoe. The bars being placed behind the coffin bone* will bear preſſure without inconvenience; and the frog, from being elaſtic, and oppoſite to elaſtic ſubſtances, was alſo intended to receive preſſure: but the ſenſible ſole being placed between the horny ſole and coffin bone,† is liable to be bruiſed from any cauſe that impedes the deſcent of the horny ſole. If, for example, a ſhoe be ſo applied as to be in cloſe contact with the horny ſole, the union of the ſhoe with the cruſt will prevent any deſcent of the horny ſole, ſenſible ſole, or coffin bone, and conſequently impede the

* See Plate IX. E. † See Plate VIII. and IX.

elon-

elongation of the laminæ. The weight of the animal being received by the coffin bone, is conveyed to the laminæ; and if the horny ſole be deprived of motion, when the ſenſible ſole is forced againſt the horny ſole, the ſenſible ſole will be bruiſed between two fixed ſubſtances, the coffin bone above, and the horny ſole below; and, from this violence, blood often extravaſates into the porous ſubſtance of the horny ſole, commonly called a corn. The motion, however, of the coffin bone will not be alike in all its parts; for the heels of the coffin bone, in conſequence of the oblique union of the ſenſible with the horny laminæ, will deſcend, not perpendicularly, towards the toe of the ſole, but obliquely backwards towards the heels. Farther, the ſenſible laminæ of the heels and quarters are not wholly connected with the coffin bone, but laterally to cartila-

ginous

ginous ſubſtances behind the coffin bone,* which are moveable, and probably contribute to encreaſe the motion of the laminæ, and the oblique deſcent backward, of the coffin bone and ſenſible ſole. Beſides, the principal flexor tendon is inſerted into the middle of the poſterior and under ſurface of the coffin bone,† and therefore limits the deſcent of all that portion of the coffin bone to which it is attached; but the heels of the coffin bone have no attachment to, and are placed behind the tendon, and extend poſteriorly much beyond the centre of that bone:‡ the heels, therefore, have a more extenſive deſcent than the anterior or centrical part of the coffin bone. That the horny ſole alters its poſition by deſcending when the foot meets the ground, and aſcending

* See Plate VII. C, C, C. † See Plate V. S.

‡ See Plate IX. L, L, L.

when the foot is in the air, we have endeavoured to prove by the facts already adduced; but, in order to confirm this opinion by the teſt of experiment, the ſpace between the ſhoe and horny ſole was filled with a quantity of plaſter of Paris, made of a ſufficient thickneſs not to eſcape by the motions of the limb. The horſe was then walked, in which action there appeared but a very trifling diſplacement of the plaſter; but, on trotting the animal, which added force to weight, a large quantity of the plaſter was diſplaced from under the ſhoe. I repeated this experiment with ſtiff clay, and the ſame reſult followed. It has alſo been found, that a ſmall ſtone, introduced with eaſe at the heels, between the ſhoe and horny ſole, or the ſhoe being in contact with the ſole, will frequently, while the horſe is ſtanding ſtill, or only walking, occaſion no inconvenience;

venience; but when his motions are quickened, the pain and lameneſs become manifeſt.

From theſe experiments and obſervations it therefore appears, that the deſcent of the coffin bone and horny ſole is, in ſome degree, regulated by the actions of the animal. Theſe facts alſo explain the cauſe of bruiſes taking place more frequently at the heels than at any part of the foot; for, although the ſole at other parts is liable to be injured from the preſſure of the ſhoe, yet the extremity of the horny ſole, between the bars and cruſt, having more motion than the ſole at any other part, is more liable to have that motion impeded by the ſhoe, and conſequently the ſenſible ſole at this part is more likely to be bruiſed. Where the horny ſole is in contact with the ſhoe, every ſtep the ani-

mal takes, the ſenſible ſole, at the heels, will be liable to receive a blow; for, as the horny ſole will be fixed, and prevented from deſcending, and as the ſmall paſtern bone will ſtill continue to convey its weight to the coffin and navicular bones, the ſenſible ſole muſt neceſſarily be liable to be cruſhed between the coffin bone above, and the horny ſole below. This diſeaſe, commonly called corns, takes place much more frequently on the inſide heel, than on the outſide, from the inner heel of the coffin bone ſupporting more of the weight of the animal than the outſide.

The elongation of the laminæ, and deſcent of the inner heel of the coffin bone, and of the horny and ſenſible ſole oppoſite, will therefore be greater than the correſponding parts on the outſide: and,

in

in proportion to the extent of motion, will the horny ſole be liable to preſſure, and the ſenſible ſole to injury. This defect ſometimes, although very rarely, takes place in the hind feet; for the coffin bone ſupports ſo ſmall a proportion of weight, when compared to that ſuſtained by the fore feet, and the heels of the coffin bone of the hind feet being placed poſterior to the body of the animal, the elongation of the laminæ and deſcent of the horny ſole is comparatively trifling. The laminæ, therefore, of the hind feet having leſs weight, the coffin bone, the ſenſible and inſenſible ſoles, muſt neceſſarily have leſs motion, and conſequently the ſenſible ſole is ſeldom liable to be bruiſed by the horny ſole. Moreover, the heels of the coffin bone of the hind feet do not extend ſo far back as the coffin bone of the fore feet; and the length of bone behind the flexor tendon being leſs, the

length

length of lever, and quantity of motion, will be diminiſhed. The ſenſible ſole, however, may be injured at any part without preſſure from the ſhoe, either before or after ſhoes have been applied; for corns are ſometimes ſeen in other parts of the ſole, and alſo in horſes that have never been ſhod. In ſuch caſes, however, it will be often found, that the horny ſole is preternaturally concave without, and convex within; and ſo morbidly thick and hard as to loſe its elaſticity, and obſtruct the deſcent of the ſenſible ſole and coffin bone. The horny ſole then becomes a fixed point, and the ſenſible ſole as liable to be jammed by the coffin bone preſſing down the ſenſible ſole againſt the immoveable horny ſole, as if the ſhoe itſelf had reſted on the horny ſole. Any cauſe, therefore, that deprives the horny ſole of motion, deprives both the laminæ and the horny ſole of their

functions;

functions; and I have often ſeen lameneſs in the fore feet to a very great degree, from the neglect of allowing the ſole to grow too thick and inelaſtic, and not ſufficiently removing the ſuperfluous and dead part of the horny ſole at each ſhoeing.

It is not my intention, in this volume, to inveſtigate the nature and treatment of corns, or any other diſeaſe; but as many of the morbid appearances tend to elucidate the œconomy of various parts of the foot, it ſeemed neceſſary to mention them in this place.

It has been ſuppoſed by ſome writers, that the uſe of the laminæ was to act as the organ of feeling; but this opinion does not appear to be well founded. The laminæ, in the firſt place, are leſs furniſhed with

nerves

nerves than the frog, and moreover, are removed from external preſſure. There is no part of the foot within the hoof, ſo much expoſed to preſſure as the ſenſible frog; but it does not appear probable, that any part of the foot performs the function of feeling. The back of the hand is as ſuſceptible of pain as the ſkin of the palm; but the fingers and palm of the hand have a ſeparate and diſtinct ſenſe to common ſenſation, which enables them, in a particular manner, to become acquainted with certain properties of matter.

The extremity of the noſe of the horſe, and not his feet, performs the ſame kind of function. If a horſe, by the ſenſe of hearing, ſeeing, or ſmelling, becomes afraid, he does not employ his feet, but his noſe for better information.

In

In deſcribing the phyſiology of the laminæ, I have occaſionally been obliged to mention the ſenſible ſole: it is now neceſſary that I ſhould more particularly point out the ſituation, the ſtructure and œconomy of this organ. This part is termed ſenſible ſole, to diſtinguiſh it from the inſenſible horny ſole. The ſenſible ſole is ſituated immediately above, and united to the upper ſurface of the horny ſole, and is firmly united to the lower concave ſurface of the coffin bone, and alſo to the lower ſurface of the inferior cartilages behind the coffin bone.* The lower edge of the ſenſible ſole is firmly connected at the lower edge of the coffin bone to the ſenſible laminæ; but, at the extremity of the heels of the ſenſible ſole, there is a continuation of laminæ for about an inch: theſe laminæ form what

* See Plate VIII. D.

has been termed ſenſible bars,* and are united to the horny laminæ on the inſide of the horny ſole. The ſenſible ſole is firmly attached above to the bottom of the coffin bone and lower part of the cartilages, and appears then to be continued over the fatty portion of the ſenſible frog.† In the ninth plate the ſenſible ſole has been ſtripped from one half of the coffin bone, one half of the ſurface of the lower cartilages, and from one half of the fatty portion of the ſenſible frog, to ſhew the parts to which the ſenſible ſole is attached. The ſenſible ſole is extremely vaſcular;‡ but, when free from blood, appears of a ligamentous nature.

The mouths of the arteries terminate obliquely from behind, forward into the pores of the horny

* See Plate VIII. H. † See Plates VIII. and IX.
‡ See Plate VIII.

ſole,

ſole, and from the numerous projecting arteries terminating in the pores of the horny ſole, they both become firmly united.

At the edge of the coffin bone, where the laminæ unite with the ſenſible ſole, the vaſcularity is much greater than at other parts of the ſole, ſo as to form a villous edge.* The ſtructure at this part is different from other parts of the foot; and the functions of the edge of the ſenſible ſole is to fill up the ſpaces between the horny laminæ, immediately after they quit the ſenſible laminæ; and from this depoſition of horn, it has been already obſerved, that the lower edge of the cruſt, to which the ſhoe is attached, appears not laminated, but ſolid horn. The original horny laminæ may, however, be ſeen

* See Plate X. 1, 2, 3.

diſtinctly,

distinctly, and if accurately observed, found to be of a different colour and texture from the horn deposited between the laminæ by the vessels at the edge of the sensible sole. It is this deposit of horn, between the horny laminæ, which forms the bond of union between the crust and the edge of the horny sole; and although these parts grow from very distinct vessels, yet a firm bond of union is formed at the edge of the sensible sole, so as to produce one complete horny box. All the blood sent to the sensible sole, and not employed in the secretion of the horny sole, is returned by the veins.

It has been already observed, that the sensible sole appears to be continued over the lower surface of the fatty portion of the sensible frog, and there is no obvious difference in the structure of these glands; yet,

yet, as the matter ſecreted from the veſſels of the ſenſible frog is very elaſtic, and different in formation and œconomy from the ſecretion of horn from the veſſels of the ſenſible ſole, it follows, that there muſt alſo be a difference of ſtructure in the glandular organs.

The blood veſſels have a different origin, and take a different courſe,; and probably, in every inſtance, the arrangement of arteries is the chief cauſe of the ſame blood being converted into various ſubſtances: but when the lower ſurface of the ſenſible ſole and ſenſible frog are injected with fine injection, or examined in the living animal, or recently after death, there appears no perceptible difference in their organization. Nevertheleſs, as the ſtructure and functions of the inſenſible frog are totally different

ferent from the ſtructure and œconomy of the horny ſole, there can be no doubt that the minute ſtructure of the vaſcular parts is diſſimilar. The uſe of the lower ſurface of the ſenſible ſole, is for the purpoſe of furniſhing a conſtant ſupply of horny ſole; and the functions of the horny ſole, now that the functions of the ſenſible and horny laminæ have been explained, admit of a clearer elucidation than could have been given without this previous knowledge.

Thoſe who ſuppoſed that the weight of the animal was chiefly ſupported by the horny ſole, have attributed a function to that organ which it does not poſſeſs; as I have endeavoured to prove, by the removal of the horny ſole, that the horny and ſenſible laminæ are capable of ſuſtaining the weight of the animal. But although the laminæ perform that function,

tion, yet, as they are elaſtic, and at every ſtep elongate, the horny ſole is neceſſarily preſſed down in the ſame degree; and by firſt deſcending, and then aſcending, as the laminæ dilate or contract, the horny ſole contributes very eſſentially to prevent concuſſion.

The uſe of the ſenſible bars is to ſecrete the horny laminæ, or internal bars of the horny ſole; and, by this bond of union, not only to ſtrengthen the attachment between the two ſoles, but alſo to aſſiſt in retaining the ſenſible frog in its proper ſituation. An intimate knowledge of the ſituation, ſtructure, and œconomy of the ſenſible frog is abſolutely neceſſary, in order to form an accurate opinion of the functions of the horny frog. Expoſing the horny frog to preſſure has been founded on the ſuppoſition, that, from its ſituation and ſtructure, it was intended

to

to meet the ground. The ſituation of the ſenſible frog is immediately above, and contained within the cavity of the horny frog; and its form, although ſomewhat ſmaller in bulk, is, in other reſpects, exactly ſimilar to the horny frog. The ſenſible frog, about the middle of its lower ſurface, is divided into two equal portions by a fiſſure or ſeparation :* and from this part iſſues a natural oily ſecretion. The horny frog has three concavities within; two at the heels, and one at the toe, to receive three convex portions of the ſenſible frog. The two concavities of the horny frog are divided in the centre by a conſiderable projection of horn: this convexity is received into a correſponding cavity between the convex heels of the ſenſible frog. From this deſcription, it will be found, that the external form of the horny

* See Plate VIII. f.

frog,

frog, and lower ſurface of the ſensible frog, are alike; both having three diſtinct concavities, and one concavity in the centre.* But, although the ſhape be ſimilar in both, yet, in many important particulars, they differ very eſſentially.

The toe of the ſenſible frog is attached to the lower ſurface of the coffin bone, immediately before the inſertion of the long flexor tendon.† This attachment takes place only about the ſpace of half an inch, and is then continued backward, for the purpoſe of being connected in part with the flexor tendon above, but more than one-third of the ſenſible frog projects behind the tendon.‡ The ſenſible frog, although not exactly equal either in

* See Plate VIII. f. † See Plate IX. G.

‡ See Plate V. N, N, N.

breadth or length to the horny frog, has, nevertheleſs, a much greater depth of ſubſtance.* The upper part of the heels of the ſenſible frog, above the cavity of the horny frog, is received between the two ſide cartilages, to which they are, laterally, firmly attached.† The whole ſenſible frog, therefore, is not all contained within the cavity of the horny frog, but a very conſiderable portion is placed above; and that part contained within the cavity of the horny frog is more denſe and leſs elaſtic in its ſtructure than the part above. The whole lower ſurface of the ſenſible frog, that is in immediate contact with the horny frog, is extremely vaſcular, and, in appearance, reſembles the ſenſible ſole:‡ but, on cutting perpendicularly through the ſenſible frog,§ its ſtruc-

* See Plate V. N. N. N.

† See Plates VIII. and IX. H.

‡ See Plate VIII. e. g.

§ See Plate V. N. N. N.

ture

ture within is found to be very different; and it is probable, that the ſenſation of the ſenſible frog is chiefly, if not wholly, confined to the red ſurface in contact with the horny frog.* The internal ſubſtance is very little vaſcular, and has few, if any, nerves; but the ſurface attached to the horny frog, and particularly the cleft of the ſenſible frog, has a conſiderable number of blood veſſels; and when inflamed, as in thruſhes, is exquisitely painful.

The internal ſtructure of the ſenſible frog is fat, cartilage, and elaſtic cellular membrane.† Fat, in the living animal, is oil, the heat of the body being ſufficiently high during life to render it always fluid. On weighing the whole ſubſtance of a ſenſible frog, it was found to be exactly thirty drachms;

* See Plate V. O. † See Plate V. N, N, N.

 but,

but, on boiling it in oil, the fatty matter eſcaped, leaving behind the cartilaginous and cellular ſubſtance, which was found to weigh only ten drachms; ſo that, after the fat or oil has been removed from the ſenſible frog, it was found to have loſt more than two-thirds of its weight. The fat of every part of the horſe (and, I believe, of every animal) is confined within circumſcribed cells, or bags, having no communication with each other. Indeed, if this was not a law of the animal œconomy, the fat being a fluid, would be always liable to eſcape, and gravitate to the loweſt parts, and not retained in thoſe organs deſtined to receive it. The cells of the ſenſible frog do not appear to be fully diſtended with oil, and the elaſtic cellular membrane and cartilaginous fibres ſeparate the cells from each other. When, therefore, any preſſure is applied

plied to the horny frog from below, it aſcends, and preſſes on the cells of the ſensible frog, and forces the bags of oil upward, and laterally againſt the inner ſurface of the ſide cartilages. If the cartilages had been fixed, this preſſure would have been often ſo conſiderable on the ſenſible frog, as probably to occaſion lameneſs. The ſenſible frog can receive no preſſure from the coffin bone above but at the toe, which is the only part attached to the coffin bone: this portion of the frog is more firm in its ſtructure than other parts; and, unlike the remainder of the frog, is attached to two fixed points, the coffin bone above, and horny frog below: and, from this inelaſtic connexion, the toe of the frog would be likely to be bruiſed, if that part of the frog had been placed immediately under the centre of the weight; but the toe of the frog always enters the ground

more or leſs obliquely, and, at the moment of percuſſion, is placed ſo much before the weight of the body as to receive no miſchief; whereas, if this part of the frog had been placed perpendicularly on the ground, immediately under the weight of the animal, the toe of the frog would then have been likely to be bruiſed between the coffin bone above and horny frog below.

It was abſolutely neceſſary that ſome part of the frog ſhould have a fixed point, and there is great wiſdom in the ſelection of that part, which, by entering the ground obliquely like a plough, is not bruiſed; for the oil contained in the cells of the toe of the ſenſible frog will not be preſſed upward to meet the coffin bone, or downward to meet the horny frog, but backward, towards other cells of the ſenſible

ſible frog. The remainder of the frog, full nine-tenths of its whole length, is placed behind its attachment to the coffin bone, and above is, in part, connected to the lower ſurface of the long flexor tendon oppoſite to the navicular bone; but the greater portion of the ſenſible frog is placed poſterior both to the navicular bone and flexor tendon.

In proportion as the navicular bone is forced down by the ſmall paſtern bone, that part of the ſenſible frog immediately oppoſite will receive preſſure from above, and the oil will preſs on other cells below, and poſterior to the navicular bone, a circumſtance which renders the deſcent of the horny frog unneceſſary. This high degree of elaſticity of ſtructure in the ſensible frog was abſolutely requiſite to prevent concuſſion; for, had the deſcent of the horny

horny frog been neceſſary; in all caſes where the frog met with any ſurface incapable of yielding, as pavement, or hard ground, this elaſtic function would have been defeated. The horny frog meeting the ground in a fixed ſtate, the ſurface of the ſensible frog would have been cruſhed between two hard bodies, namely, the preſſure of the navicular bone above, and the ground below. Theſe cauſes would operate with more or leſs violence, in proportion to the weight and action of the animal: but nature has ordained that the horny frog ſhould meet the furface of the earth for other important functions, and yet ſo wiſely conſtructed the parts, as to give great elaſticity to the ſensible frog, without any deſcent of the horny frog.

It has been very generally ſuppoſed, that the horny frog deſcended, at every ſtep, from the preſ-

ſure

ſure of the foot bones above. But neither the coffin or navicular bone can deſcend beyond the extent of the ligaments and laminæ; and the action of theſe bones is very limited, when compared to the elaſticity and motion of the ſenſible frog. No preſſure, therefore, from above, can be conveyed to the horny frog, until the more elaſtic ſenſible frog has been firſt compreſſed.* Beſides, the moſt prominent part of the ſenſible frog is its poſterior extremity, which extends conſiderably behind the bones of the foot, and cannot receive from above, the weight or preſſure of a ſingle grain.

In this point of view the frog is placed under the ſame circumſtances, and receives no more preſſure from the ſuperincumbent weight, than a ſpur pro-

* See Plate V. N, N, N.

jecting behind the bones of the foot of the human ſubject; and as the lower ſurface of the external frog alſo projects downward below the ſole, and as it is made of a wedge-like form, and elaſtic in its ſtructure; I have already had occaſion to remark, that the horny frog ſeemed to be intended to reſt on the ground. On the contrary, the concave form of the horny ſole indicated, that nature had ſo conſtructed this organ, as not to bear without miſchief either partial or general permanent preſſure.

Much knowledge of the mechaniſm of the *ſenſible* frog, to learn its functions, is not required; for the uſes of this organ may be gathered merely from the convex form and elaſtic ſtructure of the horny frog. The frogs, however, of many horſes at graſs, even before they are ſhod, are not placed on a level with

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the cruſt; and it has therefore been concluded, that nature did not intend the external frog to receive preſſure from the ground. This objection at firſt view ſeems plauſible, and certainly deſerves enquiry; but the more the ſubject is inveſtigated, the more numerous are the proofs that preſſure was intended, and that it is ſerviceable to the ſtructure and œconomy of both the horny and ſenſible frogs.

Coach, dray, and other heavy horſes, have notoriouſly the moſt prominent and moſt healthy frogs. They are often on a level with the cruſt; and theſe animals are ſeldom lame from tender frogs, thruſhes, or contracted heels: while blood, and other light horſes have more frequently ſmall and diſeaſed frogs, and that ſometimes even before the horſe has been ſhod. Now, if preſſure was injurious to the frog, it

would neceſſarily follow, that where there is moſt preſſure there would be moſt diſeaſe; and where there is the leaſt preſſure, the leaſt diſeaſe: whereas, the contrary is unqueſtionable the fact.

The heels of the ſmall horſe are often higher than his frog, and even when this meets the ground, from the ſuperincumbent weight being leſs than that of the large horſe, the preſſure is trifling, and his frogs more frequently unhealthy. It is, moreover, a well eſtabliſhed fact, that the frogs of all horſes of every deſcription are more or leſs expanded and ſound, as they are more or leſs in contact with the ground. If the earth be ſoft, or the ſurface irregular, the frog receives occaſional preſſure, and the hoof being naturally circular will rarely contract. So long, therefore, as the horſe remains

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in a ſtate of nature, that is, ſo long as the hoof is not expoſed to artificial heat, but preſerved cool and moiſt, the heels will very generally remain expanded; for although the cruſt may be higher than the frog, yet, out of the ſtable, the frog will be expoſed to preſſure. Inceſſant and exceſſive moiſture, however, often deſtroys the whole inſenſible frog and ſole, commonly called canker; but, even in this inſtance, the cauſe of the malady is the want of an adequate preſſure to the frog; and the ſame diſeaſe, and ariſing from the ſame cauſe, often attacks the feet of ſheep, known by the name of foot-rot. Where the ground is hot and hard, and the heels high, without preſſure to the frog, the hoofs of horſes out of the ſtable are liable to contraction. But nature, where no art is employed, has, in ſome degree, guarded againſt this evil; for, as ſoon as an altera-

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tion takes place in the ſtructure of the hoof, ſo as to become dry and diſpoſed to contraction, it alſo becomes brittle, and the lower edge of the cruſt often breaks off. The frog is then more expoſed to hard bodies, and therefore better able to prevent contraction, which otherwiſe would be more likely to enſue. Under theſe circumſtances, while the frogs are expoſed to the open air in a ſtate of nature, they have almoſt conſtantly ſome degree of preſſure; but if the horſe remains in the ſtable, heated perhaps by the bodies of other animals, as well as the local heat occaſioned by the fermentation of urine and fæces, and made to ſtand on the ſhoe only, then the frogs, from receiving no preſſure, will be liable to contraction. Contraction of the *horny frog* is not commonly attended to, or conſidered as a diſeaſe; but, as in all caſes where the heels of the hoof are contracted,

tracted, the contents become ſqueezed, ſo the cavity of the horny frog, by contraction, preſſes on the ſides of the ſenſible frog, and occaſions inflammation and ſuppuration, called a thruſh. For although nature has made ample proviſion in the formation of the feet of the human ſubject, as well as in the frogs of horſes, to guard againſt preſſure from the ground; yet it was never intended that either the one or the other ſhould receive any conſiderable *ſide preſſure*. There is no ſtructure to prevent the ill effects of a contracted horny frog in the horſe, or of a tight ſhoe in the human ſubject.

Where the quarters and heels of the ſhoe are higher than the frog, it has no preſſure from the ſmooth ſurface of bricks; and the light reſiſtance the frog occaſionally receives from the litter and dung, when

combined

combined with exceſſive heat, produces, rather than prevents, contraction. When, therefore, the hoof is moſt heated, and the moiſture moſt evaporated, the cruſt is moſt diſpoſed to contraction; and, during this period, preſſure on the frog is moſt wanted to open the cartilages and reſiſt contraction of the quarters: that is, while the horſe is in the ſtable, then the ſenſible and horny frogs are moſt of all deprived of preſſure, when their functions are moſt particularly required.

Thoſe who obſerve the laws of nature, will have no difficulty in aſcertaining whether it is moſt congenial to the functions of the frogs to be deprived of preſſure in the ſtable, and on all ſmooth ſurfaces, but ſtill on the road expoſed to every offenſive cauſe; or whether it is better to receive conſtant preſſure,

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and perform the ſame functions when ſhod, as before the ſhoe is applied. There would be leſs neceſſity for the heels of the ſhoe and frog to be on the ſame level, if the whole hoof was preſerved cool, or the frog, when at reſt and when in motion, allowed in any way to receive the preſſure of the ground: but as the horny frogs of horſes, while in the ſtable, are often contracted from being expoſed to artificial heat and improper ſhoes; and as the ſenſible frog, during this period, receives a great degree of unnatural ſide, but no perpendicular, preſſure when at reſt, or from ſmooth and hard ſurfaces when in motion, this organ is deprived of its functions at a period when the heat of the ſtable moſt favours contraction of the quarters, and renders the action of the frogs abſolutely neceſſary. At graſs, I have obſerved, although the heels may project downward beyond the frog, yet nevertheleſs, both

when at reſt and when in motion, the frog has occaſional preſſure, and it muſt continue to have preſſure during life, or ſuffer an alteration of its form, ſtructure, and œconomy.

Whenever, as already mentioned, the horny frog meets the ground, it is preſſed upwards againſt the ſenſible frog, and the oil with the cells of the ſenſible frog aſcend, at the ſame time that the ſmall paſtern bone preſſes down the navicular bone on the middle and upper portion of the ſenſible frog; and this counter preſſure would create great concuſſion, perhaps a fracture, if all the cells of the ſenſible frog were fully diſtended, and the frogs connected with fixed ſubſtances. For as the ſenſible frog, oppoſite the navicular bone, is preſſed on the upper, and alſo on the lower ſurface at the ſame inſtant; without a lateral expanſion of the ſide cartilages above the hoof,

hoof, ſome of the parts would be bruiſed or broken. But as the heels of the ſenſible frog are received between the two ſide cartilages, whenever part of the oil with the cells of the ſenſible frog are made to aſcend by the preſſure of the ground on the horny frog, and part to deſcend from the preſſure of the navicular bone downward, the cartilages, above the upper edge of the cruſt, are forcibly expanded; and from this expanſion, the preſſure and counter preſſure on the two ſurfaces of the ſenſible frog occaſion no violence to any of theſe organs, but afford a highly elaſtic ſpring, and preſerve the quarters, the heels, and frogs expanded.

The heat of the ſtable will, nevertheleſs, tend to contract the hoof; but while the horſe ſtands on his frogs, the oil of the ſenſible frogs is preſſed againſt the

cartilages, and the cartilages againſt the upper and lateral edges of the newly formed cruſt, which being thin, and almoſt as ſoft as the ſkin, yields to the lateral expanſion of the cartilages, and grows obliquely outward: but when the inſenſible frog is at a diſtance from the ground; as the oil of the ſenſible frog is not forced upward, the ſide cartilages are deprived of their natural expanſion, and the newly formed cruſt receives no preſſure from the cartilages. The heat of the ſtable then operates in full force to contract the cruſt, the ſole, and the frog; and I have ſeen inſtances, where the frog has been raiſed from the ground only one month, that the heels have been ſenſibly diminiſhed in width.

If the frog be raiſed above preſſure, and expoſed to heat without moiſture, I believe there is no ſyſtem

of

of ſhoeing that can poſſibly preſerve the hoofs of horſes circular. It therefore follows, that where the frog receives preſſure from the ground, the cartilages, the quarters, and the frogs are preſerved expanded, and perform their functions, and the heat of the ſtable is generally incapable of producing contraction; but the frog being raiſed above the ground, the cartilages loſe their functions, and have no power to reſiſt the contraction of the cruſt. Theſe circumſtances, therefore, fully explain what has been often repeated, that whatever form of ſhoe be adopted, if the frog does not receive preſſure in the ſtable, at reſt as well as in motion, the heels of every individual horſe will be more or leſs liable to contraction, as they are expoſed to more or leſs heat: and whatever form of ſhoe be uſed, if the frog, when at reſt, is on a level with the heels, the ſole properly thinned,

and

and the horſe allowed a proper degree of exerciſe, the hoof will continue circular.

I have ſeen a few caſes, however, of contraction, in very light horſes with ſtrong cruſts, and *thick concave ſoles*, where the frog has touched the ground, but then the horſe has had low action, and been ſuffered to remain in a hot ſtable for ſeveral days together without exerciſe; and, in horſes of this deſcription, where the weight of the animal is light, and the cruſt and ſole very ſtrong, merely ſtanding on the frog, without the influence of action added to weight, is not always ſufficient to keep the heels open. While the horſe is in motion, every ſtep of the animal adds a conſiderable degree of force to the weight, and this force gives more preſſure and expanſion to the frogs, the cartilages, and upper

ſide

ſide edges of the cruſt: but without exerciſe, that is, without the influence of action added to weight, the ſimple preſſure of the ground on the frog in the ſtable is ſometimes not alone ſufficient to reſiſt the effects of heat, and preſerve the frog, or indeed any part of the foot, in health. If the hoofs of ſome horſes cannot be preſerved circular without exerciſe, even when the frog reſts on the ground, how much more diſeaſed muſt be their hoofs, when expoſed to the ſame pernicious influence of heat and reſt, and yet no preſſure given to the frog to preſerve the parts expanded.

It is a fact well eſtabliſhed, that horſes frequently become lame from ſtanding in the ſtable, although, perhaps, the cauſe of this lameneſs has not been ſo clearly underſtood: but it ſeems probable, from the

ſtructure

ſtructure and œconomy of the foot, that whenever the frogs are deprived of preſſure, and expoſed to heat, they muſt be liable to contraction, and the contents of the hoof to inflammation and lameneſs.

When the frog touches the ground, the cartilages, in conſequence of the aſcent of the horny and ſenſible frogs, would be liable to be diſlocated from the coffin bone, if they were not limited in their action by a ſurrounding ligament, which takes the name of coronary.* It is attached by its lower edge to the origin of the ſenſible laminæ, and above to the ſkin.† The inner ſurface of this ligament paſſes rather above the coffin joint, and is attached to the anterior proceſs of the bone, and to the ſide carti-

* It was thought better to defer the deſcription of this ligament, until the parts connected with its functions were conſidered.

† See Plate X. A, A, A.

lages

lages near the middle. The outer ſurface of the ligament is convex, to be received into the concave coronary ring of the cruſt. As the ligament paſſes backward it becomes narrower, and deſcends more obliquely, till it meets the very extremity of the heels of the ſenſible frog, into which the ligament is inſerted.* The outer part of the ligament, with its covering, is convex, and received into the concave portion of the cruſt above the horny laminæ. It is covered by a very vaſcular ſubſtance, which being plentifully ſupplied with blood veſſels, gives a red appearance; and this ſurface has a conſiderable number of projecting mouths of veſſels, which terminate in a correſponding number of ſmall holes in the concave coronary ring of the cruft.† This ligament, with its covering, performs moſt important,

* See Plate III. g, g, g. † See Plate X. a, a, a.

but very different functions. The ligament being firmly united to the ſenſible laminæ, to the cartilages, coffin bone, and heels of the ſenſible frog, it aſſiſts all theſe parts in their reſpective actions.

When the ſenſible laminæ are put on the ſtretch, by ſupporting a great part of the weight of the animal, their ſtrength and union with the coffin bone and cartilages is increaſed, by being connected above to the coronary ligament: but another very eſſential uſe performed by the ligament, is that of preſerving the cartilages in their proper ſituation.

When the horny frog touches the ground, and the ſenſible frog is forced upwards, and the cartilages outward, they would be liable to a diſlocation or ſeparation from the coffin bone, if they were not limited

limited in their expanſion by the ſurrounding coronary ligament. The vaſcular covering to the ligament performs the function of a gland. The mouths of the veſſels project, and are received into the pores of the concave coronary ring, and are perpetually employed in ſecreting the cruſt. The ſmooth cruſt begins to be formed at the upper edge of the vaſcular ſurface, immediately below the hair, and it continues to receive an additional quantity of horn during the whole of its deſcent. The cruſt, therefore, is very thin at its commencement, but acquires additional matter throughout its whole extent, from the coronet to the lower part of the hoof which receives the nails. The inner and upper ſurface of the cruſt, forming the coronory ring, is ſmooth and porous; but, at the lower edge of this ring, the horn begins to be laminated. This ſtrongly marked differ-

ence between the internal ſurface of the cruſt at the coronary ring, and the cruſt immediately below, ariſes in conſequence of a quantity of horn being depoſited by the veſſels of the ſenſible laminæ. The edges, as well as the ſides of the ſenſible laminæ, have arteries with open mouths which convert blood into horn, and as the cruſt during life, deſcends from the coronet downward, it receives on its inner ſurface a ſupply of horny laminæ, as ſoon as, but not before, it leaves the coronary ring; and as every part of the vaſcular laminæ depoſit horn, the cruſt becomes thickened throughout the whole of its deſcent. The cruſt is thickeſt at the toe of the hoof; for, as the length of cruſt, from the coronet to the toe, is greater than the depth of cruſt at the heels and quarters, and as the cruſt receives new matter during its whole growth, it neceſſarily follows, that the lower

edge

edge of the cruſt at the toe having paſſed over more blood veſſels than the lower edge of the heels and quarters, it muſt acquire at this part more horny matter. This additional ſtrength of cruſt, at the toe of the hoof, was a wiſe proviſion in nature, to keep pace at this part with the increaſed conſumption of horn. The heels and quarters are leſs expoſed to friction, and therefore there was no occaſion for the heels and quarters to be equally thick with the toe. Where there is moſt wear, there we find the moſt ſtrength. That there ſhould not be an equal deſtruction of horn at the poſterior parts of the foot, might, from the ſituation and ſtructure of the parts, be expected; for as the heels of the hoof are placed behind all the bones of the foot and leg, they receive no proportion of the ſuperincumbent weight, and are therefore not liable to the ſame de-

gree

gree of deſtruction as the cruſt ſurrounding the coffin bone: but, as the lower edge of the cruſt, at every part, is, from attrition, more or leſs daily worn away, to furniſh new matter, it was requiſite that there ſhould be a daily ſupply. It is farther a law of nature, that as, during moiſture, there is moſt conſumption of horn, ſo at this period there is always the greateſt growth. In ſummer, when the hoof is removed from moiſture, the horn becomes hard, and the conſumption diminiſhed; but, during this period, the growth is alſo leſſened. Having examined the bones, ligaments, and cartilages of the foot, and alſo the ſtructure and functions of the coverings of the coffin bone, it will now be neceſſary to deſcribe the muſcles that move the foot and paſtern bones.

THE MUSCLES OF THE FOOT.

THERE are three muſcles attached to the bones contained within the hoof of the fore foot; two to bend, and one to extend the foot. The two muſcles employed to bend the foot bones, are named the flexor perforatus, and flexor perforans. The ſhort flexor, or flexor perforatus, ariſes from the inner and lower head of the ſhoulder bone, in common with the muſcular fibres of the long flexor, or flexor perforans. Immediately above the back part of the knee joint, the tendon of the ſhort flexor muſcle paſſes on the inner ſide of a ſmall projecting bone, at the back and outer part of the knee joint, and deſcends immediately over the tendon of the perforans muſcle. A ligament ſurrounds both the tendons oppoſite the back part of the knee joint, and

contains

contains a fluid to lubricate the action of both tendons: theſe tendons alſo paſs contiguous to the inſertion of the inner flexor muſcle of the knee joint. Below the knee, the ſhort flexor tendon, on its inner ſurface, is ſomewhat concave, to embrace the convex ſurface of the long flexor tendon, to which it is ſlightly attached by cellular membrane. This union between the tendons is continued downward, from the back of the knee, to nearly the upper edge of the ſeſamoid bones; and, at this part, the tendons are more cloſely united by cellular membrane. The ſhort flexor tendon then ſpreads, and forms a ſheath to ſurround, but not to touch the tendon of the flexor perforans. Between the ligament that ſupports the upper part of the two ſeſamoid bones above, and the lower part of the fetlock joint, there are three mucous capſules;* and

* See Plate VI. b, b, b.

between this ligament, and the tendon of the flexor perforans, and alſo between the tendon of the flexor perforatus, and the tendon of the flexor perforans, there are bags of the ſame ſtructure, and performing the ſame function.*

The ſheath is attached to the lateral and poſterior edges of the large and ſmall paſtern bones, and alſo a little above the coffin joint, to the flexor perforans tendon, and to the upper fatty portion of the ſenſible frog. The external and inferior part of the ſheath, oppoſite the back part of the ſmall paſtern bone, and immediately above the upper portion of the ſenſible frog, is very thin;† but the ſheath above is much thicker, from being covered by a denſe tendinous faſcia; and, oppoſite the back part of

* See Plate VI. d. d. d and f, f. † See Plate IV. B, B, B.

the ſeſamoid bones, the ſheath is ſtill farther thickened and ſtrengthened by a ſurrounding ligament. Within the ſheath, about the middle of the large paſtern bone, there is a ſmall adheſion, by thin flat cellular membrane, between the anterior ſurface of the long flexor tendon and the poſterior ſurface of the long inferior ligament of the ſeſamoid bones. This ſubſtance is elaſtic, and therefore allows the navicular bone to preſs down the long flexor tendon without affecting the ſheath; and alſo aſſiſts the ſheath to prevent the flexor tendon from riſing when the muſcle contracts. Near this adheſion, within the ſheath, there is a pouch or bag open above, but cloſed below, and contains a fluid: there is alſo another bag of the ſame nature oppoſite the upper edge of the ſeſamoid bones. Theſe bags appear to perform a double function, that of containing a

mucus,

mucus, and, at the ſame time, to ſtrengthen and unite the two ſides of the ſheath anterior to the long flexor tendon. The whole cavity of the ſheath contains a quantity of *mucus*, and prevents the flexor perforatus tendon from touching the tendon of the flexor perforans. The uſe of the ſheath is to confine the tendon, and ſtrengthen the action of the flexor perforans muſcle; for, without the ſheath, whenever the muſcle contracted, the tendon would riſe up from the paſtern bone, and not produce that degree of flexion which is neceſſary to complete the motions of the animal. The action of the flexor perforatus muſcle is to aſſiſt in bending the knee, and alſo to bend the large and ſmall paſtern joints.

THE FLEXOR PERFORANS is a triceps muſcle, having three diſtinct heads. The longeſt head takes

its origin from the inner and lower head of the os humeri, or ſhoulder bone, in common with the flexor perforatus muſcle. At a ſmall diſtance below, it ſeparates from the flexor perforatus, and, at the back of the knee, becomes tendinous. The ſecond head of this muſcle takes it origin from the inner ſurface of the ulna, and joins the large head, by tendinous attachment, oppoſite the knee joint. The third and ſmalleſt head ariſes from the back part of the radius, and becomes tendinous oppoſite the knee joint; at which part it unites with the principal tendon, formed by the junction of the two larger heads of this muſcle. All theſe tendinous fibres unite into one flat tendon, on the inner ſide of the flexor perforatus tendon. Both the flexor perforatus, and perforans tendons, are here ſurrounded by a ligament, and covered by a fluid, to prevent friction. A little

below

below the back part of the knee joint, the flexor perforans tendon becomes rounded, and united to a long flat ligament which paſſes obliquely upward, to be attached to the back part of the knee joint. This ligament tends very conſiderably to ſtrengthen the flexor perforans tendon. Above the fetlock joint, the flexor perforans tendon paſſes under a ligament through the cavity of the ſheath. It is there covered by a fluid; and, about the middle of this cavity, the anterior ſurface of the flexor perforans tendon is attached, by elaſtic cellular membrane, to the back part of the lower ſuſpenſory ligament.* Below this adheſion, the flexor perforans tendon is again looſe within the ſheath, until its meets the upper ſurface of the ſenſible frog, to which the poſterior ſurface of this tendon is in part attached. The

* See Plate IV. fig. I. and II.

anterior

anterior ſurface of the tendon, nearly oppoſite, is ſomewhat thickened, and receives a ligament from the whole upper edge of the navicular bone. The tendon is then continued over the whole lower ſurface of the navicular bone, which is covered by cartilage, and alſo by a fluid ſimilar to ſynovia or joint oil. The tendon at this part is thickened, and immediately below expanded, to be inſerted into the poſterior concave ſurface of the coffin bone.* The uſe of the flexor perforans muſcle is to bend the coffin bone, and to aſſiſt the flexor perforatus in bending the ſmall and large paſtern bones and knee joint.

THE EXTENSOR OF THE FORE FOOT. There is only one extenſor muſcle to move the bones con-

* See Plate V. S.

tained

tained within the hoof of the fore foot, but there is a ſeparate extenſor muſcle inſerted into the long extenſor ligament of the large paſtern bone. The large head of the extenſor muſcle of the fore foot, ariſes from the lower and back part of the os humeri, becomes tendinous about the middle of the radius, and is then continued under a broad ligament at the anterior part of the knee, which contains a fluid, and confines the action of the tendon. The tendon is connected to the anterior part of the cannon bone, to the large and ſmall paſtern bone, and is then inſerted into the anterior and ſuperior proceſs of the coffin bone. About the middle of the large paſtern bone, the extenſor tendon is conſiderably ſtrengthened, by being blended with the lateral ligaments, one on each ſide,* given off by

* See Plate III. d, d, d.

the

the ſuperior flexor ſuſpenſory ligament, and alſo by a long flat ligament, which takes its origin from the outer ſurface of the ligaments at the back of the knee, and deſcends obliquely, forward and downward, to be inſerted into the lower part of the large paſtern bone, on the outer ſide of the extenſor tendon.* This ligament, a little below the knee, receives the tendinous inſertion of another extenſor muſcle, which takes its origin from the outer and ſuperior part of the head of the radius. It is then continued downward on the outer edge of that bone, and a little above the knee joint the muſcle becomes completely tendinous, and paſſes through a long ſheath on the lateral and external ſurface of the knee joint, and is finally inſerted, a little below the knee, into the long flat ligament of the large paſtern

* See Plate III. B.

bone.

bone. The inner lateral edge of the long extenſor ligament is united at the anterior and upper part of the cannon bone, to the tendon of the extenſor muſcle of the foot. The ſmall extenſor muſcle, inſerted into the extenſor ligament, anſwers the double purpoſe of increaſing the ſtrength of the ligament, and the motions of the large paſtern bone. The uſe of the principal extenſor muſcle is to extend the large and ſmall paſtern bones and coffin bone, and alſo to aſſiſt in extending the knee.

THE MUSCLES OF THE HIND FOOT.

THE flexor perforatus muſcle of the hind foot ariſes tendinous, a little above the lower external condyle of the os femoris, or thigh bone, and deſcends under the fleſhy part of the gaſtrocnemius muſcle. It ſoon becomes muſcular; but about three

inches above the os calcis, it again becomes tendinous, and paſſes between the tendons of the gaſtrocnemii muſcles. The tendon of the flexor perforatus poſticus muſcle then expands, and completely covers the external ſurface of the gaſtrocnemii tendons, and becomes laterally attached to the ſides of the os calcis. The point of the os calcis receives the inſertion of the gaſtrocnemii tendons, and the inſertion of the tendons is covered by a vaſcular membrane, which ſecretes a fluid to ſeparate the flexor perforatus tendon from the gaſtrocnemii tendons. Below the os calcis, the flexor perforatus tendon, for about two inches, becomes united to the flexor perforans tendon; but the union from this part to the fetlock joint is very ſlight, and the tendon is a little concave on its inner ſurface to receive the flexor perforans tendon. From the fetlock joint,

downwards,

downwards, the flexor perforatus poſticus tendon is attached to the paſtern bones, the ſame as the flexor perforatus of the fore foot. As this muſcle takes its origin under the gaſtrocnemii muſcles, and as the tendon then paſſes over the external ſurface of the gaſtrocnemii tendons, they mutually aſſiſt and ſtrengthen each other; and as the flexor perforatus tendon is attached to the ſides of the os calcis, there is a cavity formed over the point of the hock, which contains a fluid for the purpoſe of allowing extenſive motion in this bone, without friction againſt the inner ſurface of the flexor perforatus tendon. An opening made at the projecting point of the hock, would therefore allow the mucus to eſcape, expoſe a cavity, and produce great inflammation. The flexor perforatus poſticus muſcle not only bends the paſtern bones, but at the ſame time extends or ſtraightens

the hock, by drawing the point of the os calcis directly upward; ſo that this muſcle acts both as an extenſor and as a flexor:—an extenſor of the hock, but a flexor of the paſtern joints.

THE FLEXOR PERFORANS POSTICUS muſcle ariſes by two heads; the largeſt from the outer head and back part of the tibia. A little above the hock joint this muſcle becomes tendinous, and paſſes within a groove on the inner ſurface of the os calcis, over the back and lower head of the tibia and aſtragulus. The inner ſurface of the groove is covered by cartilage, and the tendon is ſomewhat flat, and ſurrounded by a ligament which contains mucus to prevent friction. This ligament alſo confines the action of the tendon. Below the ligament, the tendon of the flexor perforans becomes rounded,

and,

and, for about two or three inches, is cloſely attached to the flexor perforatus; but the remainder portion, down to the ſheath, is only ſlightly connected with the flexor perforatus. The ſecond ſmaller head of the flexor perforans muſcle ariſes, by muſcular attachment, from the back part of the tibia, and is ſomewhat blended with the larger head of the ſame muſcle. About the middle of the back part of the tibia, it ſends off a very ſmall tendon, which paſſes on the inner ſide of the hock, through a ſmall groove in the lower head of the tibia, and obliquely backwards over the aſtragulus; at which part this tendon is kept down by a ſhort ligamentous ſheath, and contains a fluid. A little below this ſheath, the ſmall tendon unites with the principal tendon of the flexor perforans. In the hind extremities there is no ligament to connect the tendon

of

of the flexor perforans with the bone above, as in the fore extremities. In conſequence of the head and neck being ſupported by the fore extremities, this additional ſtrength is very highly uſeful, but not neceſſary behind where the weight is conſiderably leſs. Oppoſite the fetlock joint the flexor perforans tendon becomes flat. Within the ſheath, and below the fetlock joint, the tendon of the flexor perforans poſticus has the ſame attachments and functions as the flexor perforans of the fore foot.

THE EXTENSOR OF THE HIND FOOT. Although there is but one extenſor tendon inſerted into the foot bones, yet this tendon is connected above with different muſcles. The extenſor muſcle of the hind foot ariſes tendinous from the inferior head of the os femoris, or thigh bone, a little on the outſide of the

the patella, or knee pan, and is cloſely united to a ſtrong tendon of the extenſor muſcle of the cannon or large metatarſal bone. It ſoon becomes muſcular, and is covered by a faſcia. A little above the hock joint, the extenſor muſcle becomes tendinous, and paſſes under a ſtrong ligament immediately oppoſite the bend of the hock, the ſeat of a diſeaſe, commonly called a bog ſpavin. Below this ligament the tendon is continued through a ſheath for about two inches, and, at the termination of this ſheath, the tendon is ſtrengthened by a ſmall collection of muſcular fibres attached to the tendon; to the anterior and upper part of the cannon bone, and alſo to the ligament covering the anterior part of the hock joint. Near the inſertion of theſe muſcular fibres, the tendon of the extenſor muſcle is joined by another tendon, which paſſes obliquely upward, within

another

another ſheath on the outer ſide of the hock joint. A little above the joint this tendon becomes muſcular, and is continued upward to be united to the external edge of the tibia, and alſo to the upper head of that bone. The tendons of theſe muſcles unite below to form one tendon near the anterior and upper head of the cannon bone, and then become ſomewhat expanded, and attached to the lower and anterior head of the cannon bone. The tendon is continued ſtill farther downward, over the anterior part of the large paſtern bone, and about the middle of that bone receives the inſertion of the upper ſuſpenſory ligaments, the ſame as in the fore extremities. The tendon, united with the ſuſpenſory ligaments, ſpreads over the anterior and lower part of the large paſtern bone, is alſo attached to the anterior ſurface of the ſmall paſtern bone, and finally

finally inſerted into the anterior proceſs of the coffin bone. The uſe of theſe muſcles is to extend the coffin bone, the ſmall and large paſtern bones, and alſo the cannon bone. There is no long extenſor ligament in the hind, as in the fore extremities.

THE ARTERIES, VEINS, &c. OF THE FOOT.

The arteries that ſupply the fore feet with blood take their origin from the anterior aorta; and being continued downward from the ſcapula and os humeri of each leg, they divide a little above the fetlock joint into two principal veſſels, one on each ſide of the lateral and poſterior edges of the ſeſamoid bones. At the anterior and poſterior part of the artery there are ſeveral communicating branches, given off for the purpoſe of preſerving a

free communication with each other; but the two firſt important branches, given off from each trunk, are of conſiderable length, altho' ſmall in ſize.* They take their origin a little above the middle of the large paſtern bone. They are then continued obliquely downwards and forwards, and, about the middle of the ſmall paſtern bone, theſe branches terminate in a tranſverſe artery, commonly called the inferior coronary artery, which ſends off ſeveral ſmall arteries to ſecrete the cruſt.

It is worthy of remark that, in oppoſition to the general diſtribution of arteries, theſe veſſels do not take their riſe from the neareſt trunk; but, like the ſecreting arteries of the teſticles, are placed at a conſiderable diſtance from the principal trunk which

* See Plate XI. F, F.

ſupplies

ſupplies them with blood. The obvious intention of this deviation from the common diſtribution of blood veſſels, is to render the circulation ſlow in the ſmaller branches, and thereby to enable the arteries to perform the function of ſecretion.

There are ſeveral branches of arteries at the back of the paſtern bones, between the large and ſmall paſtern joints, which ſerve merely to keep up a conſtant communication with the two principal trunks; but, a little below the ſmall paſtern joint, there is an artery which has had the name of ſuperior coronary.* It takes its origin from each contiguous trunk, and then meets to form one diſtinct veſſel at the anterior part of the ſmall paſtern bone, a little below the ſmall paſtern joint. From this peculiar

* See Plate XI. g, g.

circulation of the blood, it appears, on mechanical principles, that the ſtream of blood meeting in this tranſverſe artery from each trunk, muſt impede the paſſage of the blood, and render the circulation ſlower. This artery, however, is not for the purpoſe of carrying on the circulation in either trunk when the other may receive preſſure; for there is an outlet for all the blood it receives, by means of two ſhort oblique branches, which carry the blood into a ſecond or inferior coronary artery.* The ſole uſe, therefore, of the ſuperior coronary artery appears to be that of furniſhing a conſtant, but gradual, ſupply of proper, ſlowly circulating blood to the artery below. The inferior coronary artery has, conſequently, two ſources to furniſh the ſupply of blood; and although the veſſels of each are

* See Plate XI. h, h, and i, i.

diſtributed

diſtributed very unlike each other, yet in both the arrangement of the arteries produces the ſame ultimate effect.

The arteries that are placed perpendicularly have neceſſarily a ſlow circulation, from the origin and termination of theſe veſſels being very remote; and the circulation in the oblique branches is retarded, in conſequence of the blood having paſſed from a perpendicular to a horizontal direction. But the blood, in the inferior coronary artery, muſt move ſtill ſlower; for, being placed tranſverſely, the perpendicular branch on one ſide muſt neceſſarily oppoſe the perpendicular branch of the oppoſite, and, by the equal contraction of theſe veſſels, the blood is forced downwards into the perpendicular ſmall branches, to ſupply the glandular covering of the coronary

nary ligament. A ſlow circulation is perhaps neceſſary for moſt ſecretions, as the veſſels of glands generally take a circuitous or ſerpentine courſe; and therefore it happens, when inflammation takes place in glands, that the natural ſecretion is diminiſhed or totally ſtopt. A little above the ſuperior coronary artery, at the back part of the ſmall paſtern joint, there is a conſiderable branch given off on each ſide, and being continued about an inch obliquely downwards, they divide into two. The outſide branch, on each ſide, is diſtributed to the toe of the frog, and communicates with one or two veſſels of the ſenſible ſole.* The other branch is diſtributed to the cleft of the ſenſible frog, and ſecretes that convex horny ſubſtance in the centre of the horny frog. Some of theſe veſſels, moreover, ſecrete a ſmall quantity of

* See Plate XII. d, d, F, F, and g, g.

moiſture

moiſture, which paſſes out between the external cleft of the horny frog.

When the cavity of the horny frog is diminiſhed, from a contraction of the hoof, the ſenſible frog becomes ſqueezed and inflamed; and, in order to alleviate the inflammation ariſing from lateral preſſure, the arteries ceaſe to ſecrete their natural fluid, but produce a diſcharge of matter from the cleft of the frog. In the heels of the coffin bone there are two ſmall holes, through each of which there paſſes on each ſide a branch of an artery obliquely downwards, in a groove of the coffin bone, to be diſtributed to the ſenſible laminæ.* Theſe arteries then terminate in two ſmall holes, to communicate with veſſels within the coffin bone. The

* See Plate XI. L, L, L, L.

two

two trunks are placed cloſe to the ends of the navicular bone, and then ſuddenly form an angle obliquely inward.* In the coffin bone, at the poſterior part below the navicular, there are two ſuperficial grooves, about an inch in length, to receive theſe veſſels, and they then enter the coffin bone through two large foraminæ, immediately above the attachment of the flexor tendon to the coffin bone. The circulation of the blood within, and at the lower edge of the coffin bone, is more remarkable for its beautiful œconomy, than the diſtribution of blood to any other part. The blood ſent to the bottom of the foot to ſupply the ſenſible ſole, and to ſecrete the horny ſole, does not paſs over the anterior or poſterior ſurface of the coffin bone; as the blood, in the one caſe or the other, would be much

* See Plate XII. J, J.

obſtructed

obſtructed in its circulation. But in order to ſupply all thoſe parts with blood, without any inconvenience ariſing from preſſure, the coffin bone, from its internal ſtructure, allows a free paſſage for the blood, and at the ſame time completely protects all the veſſels. Within the coffin bone, the two arteries form a curvature in the oppoſite direction to the arteries on the outſide of that bone.* The arteries, at the termination of the ſecond curvature, are placed nearly in the ſame direction as the original trunks, but a third curvature takes place at this part on each ſide; and about one inch above the toe of the coffin bone both theſe trunks meet, and unite to form one ſingle artery. This internal coronary artery forms a more complete circulus arterioſus, than is found in any part either of the horſe or the human

* See Plate XII. k, k, k, k.

ſubject. If one trunk is totally ſtopt, the circle below will not be diſtended with the ſame force, but as completely filled with blood as before.

The whole contents of the circulus arterioſus paſſes through the coffin bone, and the greater part goes to furniſh the ſenſible ſole with blood. But there are alſo ſmall arteries, given off by the circulus arterioſus, which paſs through correſponding foramina in the convex ſurface of the coffin bone above the lower edge, to ſupply the ſenſible laminæ with blood, for the purpoſe of ſecreting the horny laminæ.

As moſt of theſe veſſels are given off at right angles, and as the greater part of the blood, before it reaches the ſenſible ſole, is depoſited in the anterior

coronary

coronary artery, the motion of the blood is conſiderably retarded. The circulation in the anterior coronary artery is eſſentially different from any other part I have yet examined, either in the human ſubject or other animals. This artery is ſituated cloſe to the inferior edge of the coffin bone, and receives the blood, to be afterwards diſtributed to the ſenſible ſole. About thirteen conſiderable veſſels paſs from the circulus arterioſus, through correſponding holes at the edge of the coffin bone, immediately above the anterior coronary artery, into which they terminate. This artery alſo receives a ſmall branch from each trunk, on the outſide of the coffin bone, which branches form a conſiderable angle before they enter the anterior coronary artery. Their ſize is nearly equal to either of the communicating branches between the circulus arterioſus and anterior

coronary; ſo that the quantity of blood furniſhed by the external trunks bears about the ſame proportion to the blood, derived from within the coffin bones, as two to thirteen. The anterior coronary artery is continued not only poſterior to the communicating veſſels coming from the circulus arterioſus, but even extends behind the branches received from the trunks on the outſide of the coffin bone. On the poſterior ſurface of the anterior coronary artery, about the ſame number of veſſels paſs out directly backward, to ſupply the ſenſible ſole with blood, as were received from the circulus arterioſus within the coffin bone; but the veſſels diſtributed to the ſole are not a continuation of the arteries ſent from the circulus arterioſus, neither do the arteries of the ſole take their origin immediately oppoſite the termination of the veſſels into the circulus arterioſus.

Always one, and generally two, of the veſſels of the ſenſible ſole, are continued as far back as the toe of the ſenſible frog, and communicate with the arteries of that organ. The anterior coronary artery, in its functions, is ſomewhat ſimilar to the venous ſinuſſes of the head. As they diminiſh the force of the circulation, ſo the anterior coronary artery forms the connecting medium between the veſſels within, and the veſſels at the lower ſurface of the coffin bone, and thereby neceſſarily retard the paſſage of the blood. This very peculiarly ſlow circulation is moſt clearly intended to render the blood fit for the ſecretion of horny ſole. Had there been no anterior coronary artery, for the reception of blood coming from the circulus arterioſus, the blood would have paſſed with ſo much force to the ſenſible ſole, as probably to have deſtroyed the œconomy of the

gland,

gland, viz. that of ſecreting the horny ſole. But as the principal veſſels ariſe from the junction of the two trunks, and as theſe veſſels firſt depoſit their contents in a circular canal before the ſecreting arteries are ſupplied with blood, the force of circulation muſt be materially diminiſhed. The action of blood veſſels at all times, and in all parts, is influenced by the power of the heart, and therefore it appears, that parts of ſimilar ſtructure, which are moſt diſtant from the heart, have the ſloweſt circulation.

The great toe of the human ſubject is the part moſt liable to be affected by froſt, or gouty inflammation; and the heels of the hind legs of horſes, in like manner, being fartheſt from the heart, have ſlow circulation, and are moſt liable to greaſe and other diſeaſes. On the ſame principles, it ſeems highly

highly probable, that the intervention of the anterior coronary artery, by encreaſing the diſtance between the ſenſible ſole and circulus arterioſus, muſt render the circulation of the blood particularly ſlow. It is, moreover, an important advantage gained by this ſtructure, that the anterior coronary artery muſt be perpetually filled with blood, even if half the arteries, going from the circulus arterioſus into the anterior coronary, are ſtopt. So long, indeed, as one veſſel of communication remains entire, the anterior coronary will have blood capable of ſupplying the arteries of the ſenſible ſole. Whereas, if the ſole had been furniſhed at once from the circulus arterioſus, that organ would have had a deficiency of blood at thoſe parts where there was moſt preſſure. The whole of the veſſels of the ſenſible ſole, at every ſtep, are preſſed upon by the deſcent and conſequent preſſure of the

coffin

coffin bone above, and horny ſole below; and, without a conſiderable anaſtamoſis, the circulation would be ſtopt.

From the actual ſtructure, the whole of the ſenſible ſole will have the ſame quantity of blood, and therefore the ſecretion of horn, in all its parts, will be alike; but, without that beautiful organization, a large quantity of horn might be formed at ſome parts, while at others the quantity of blood would be too ſmall for the ſecretion to be equal to the conſumption. The paſſage of the blood, therefore, through the coffin bone, has two important uſes; firſt, to render the circulation ſlow, and ſecondly, to prevent preſſure on the blood veſſels. The whole of the ſenſible covering to the foot of the horſe, is to be conſidered as a gland, conſtantly ſecreting horn.

The

The vaſcularity of theſe parts furniſhes new matter every day, probably every minute; and all the blood ſent to the foot, not conſumed in the ſecretion of horn, is returned back by veins into the circulation. If the veins had returned their blood through the coffin bone, it muſt have been made ſo porous, as to have rendered the bone too weak to ſupport the weight of the animal. It therefore ſeemed neceſſary, that the blood ſhould not return through the coffin bone, but go a different courſe: and, in conſequence of the veins paſſing over the ſurface of the coffin bone and cartilages, theſe veſſels are neceſſarily expoſed to occaſional preſſure; but that degree of preſſure will be found, when their ſtructure is examined, to be productive of no inconvenience. They take their origin from the termination of arteries diſtributed to the ſenſible parts of the foot; and

the blood at each circulation is returned by the ſmall arteries into minute veins. Theſe veins, on the ſole of the foot, are beautifully arranged, and reſemble irregular net work. They terminate, at the lower edge of the coffin bone and cartilages, and convey their contents into the veins of the ſenſible laminæ. The veins of the ſenſible laminæ, and coronary ring, are not diſtributed in the ſame manner as the veins of the ſole; but they freely anaſtamoſe and aſcend obliquely over the coffin bone and cartilages, becoming larger and larger from their origin to their termination. Immediately above the coffin joint, at the anterior part, theſe veſſels terminate in the inferior coronary vein. This vein is continued tranſverſely over the lower head of the ſmall paſtern bone, a little above the coffin joint, and terminates laterally in two principal trunks below the ſmall paſtern

tern joint. Theſe trunks then aſcend at the ſides of the ſmall and large paſtern bones, on the outſide of the artery; and, a little above the large paſtern joint, they unite to form one ſingle trunk. Near the centre of the inferior coronary vein, a large branch aſcends obliquely upwards, to communicate with the middle coronary vein. The middle coronary vein is partly ſituated under the inſertion of the extenſor tendon, and alſo receives blood laterally from the veins of the ſenſible laminæ covering the cartilages.

The ſuperior coronary vein takes its origin laterally from the middle coronary vein, and ends in the ſame vein on the oppoſite ſide. The veins covering the poſterior part of the cartilages and ſenſible frog, return their blood at once into the back part of the principal trunk on each ſide, while the blood, coming

from the anterior parts of the foot, is firſt depoſited in tranſverſe branches before it reaches the trunks; but the cavities of both of the veins together are not one tenth part the ſize of the innumerable branches covering the anterior and lower ſurface of the coffin bone. As ſome of theſe veins, from their ſituation, are immediately in contact with the horny as well as the ſenſible laminæ, and others placed between the coffin bone and horny ſole, they muſt be ſubject to frequent preſſure.

It has been already obſerved, that every ſtep the horſe takes, and more particularly in violent exertion, the ſenſible and horny laminæ elongate, and conſequently the coffin bone, with the ſenſible ſole, deſcend on the horny ſole, and when not improperly obſtructed by the ſhoe, the horny ſole alſo deſcends;

deſcends; but that degree of preſſure, which is ſufficient to make the horny ſole deſcend, muſt at the ſame time preſs on the veins, and, for the moment, produce a temporary ceſſation to the circulation. And when the horny frog meets the ground with force, and aſcends to expand the cartilages, the veins covering the frog and cartilages will probably receive a ſlight degree of preſſure, and alſo put a momentary ſtop to the circulation. Nevertheleſs, the very frequent communication of the different branches, and the vaſt multitude of veins altogether, furniſh cavities ſufficient to contain the blood without miſchief or inconvenience.

Mr. Moorcroft, in his late publication on Shoeing, perfectly accords with me in two moſt important principles of ſhoeing, viz. that every part of the

lower

lower edge of the cruft ſhould be in contact with the ſhoe, and that THE SHOE SHOULD IMPART NO DEGREE OF PRESSURE TO THE HORNY SOLE. Page 5, line 6, Mr. Moorcroft obſerves, "That the ſenſible parts within the hoof do not ſuffer, if the "cruft or wall have a proper bearing on the ſhoe; "but if the horny or outer ſole bear upon the ſhoe "in any conſiderable degree, that the ſenſible or "inner ſole being pinched between the iron and "horny ſole below, and the bone of the foot above, "the horſe is lamed." As, in theſe very important principles of ſhoeing, I perfectly agree in opinion with Mr. Moorcroft, it ſimply remains to be ſhewn, whether the practice of ſhoeing recommended by Mr. Moorcroft, or the practice adopted at the Veterinary College, beſt accords with theſe principles. That the ſole ſhould not receive preſſure from the

ſhoe,

ſhoe, muſt, by every man who has attended to the ſubject, be felt and acknowledged; for, in thoſe caſes where the ſole receives permanent preſſure from the ſhoe, the horſe invariably ſuffers. The propriety therefore of the principle, which recommends the ſole to be at a diſtance from the preſſure of the ſhoe, can ſcarcely be doubted; for indeed the common practice of opening the heels, removing the bars, and applying a ſhoe with its upper ſurface concave, although contradictory in their real effects to this principle, was, nevertheleſs, founded on a conviction, that the horny ſole could not with impunity allow the preſſure of the ſhoe.

If the College practice of ſhoeing be inconſiſtent with theſe principles, viz. that of giving preſſure to the whole cruſt and bars, but none to the ſole, then

it

it muſt follow, that either the principles or practice, or both, are founded in error. If the principles are juſt, but at variance with the practice, in that caſe the practice muſt be pernicious; and if the practice be perfect, and yet not congenial with the principles, then the principles muſt be ill founded.

Mr. Moorcroft has endeavoured to prove, that, although the College practice of making the horny ſole hollow, and leaving the cruſt to project below the ſole, is compatible with the principle, and will allow of a ſhoe to be applied with a flat upper ſurface oppoſite the heels and quarters of the cruſt, without giving any preſſure to the horny ſole; yet the ſame Author contends, that the horny ſole will, by this removal, be ſo much weakened, as to deprive the ſenſible ſole of its natural defence, and make it liable

liable both to accidents and diſeaſes. Page 7, line 7, he ſays, "It can ſcarcely be doubted, but that a "cavity between the ſhoe and ſole is neceſſary, not "only to prevent actual preſſure, but alſo to admit "a picker to remove the dirt, which, if not taken "away, would produce the ſame effect as if the ſole "itſelf were to reſt on the ſhoe: but, though by "this means the cruſt is certainly brought to bear "on the ſhoe in its whole extent, and preſſure on "the ſole avoided, yet cutting away the ſole muſt "neceſſarily weaken it, and by continually putting "on the ſtretch the bands which tie the bone of "the foot to the cruſt, and which ſling or ſuſpend "it within the hoof, make them leſs capable of re-"ſiſting the conſtant preſſure downwards." Again, page 8, line 24, "This practice of cutting away the "horny ſole, likewiſe by depriving the ſenſible ſole

"of a portion of its natural defence, renders it "liable to be bruiſed, or wounded by ſtones, or "other hard bodies." Now, if this ſtatement be correct, then it will follow, that although the College practice be in harmony with theſe principles, acknowledged by both to be juſt, yet the miſchief done to the ſenſible ſole, and other parts, by the horny ſole being improperly removed, and left preternaturally thin, renders the practice pernicious. But if it ſhould be demonſtrated, that the horny ſole may be made concave, and yet left as thick in ſubſtance, or, if neceſſary, much thicker than the natural healthy ſole, and even thicker than Mr. Moorcroft, or any other practitioner, allows to be neceſſary, then it muſt be allowed, that Mr. Moorcroft's objections to leaving the ſole concave are groundleſs; and that the College practice of leaving the cruſt to

project

project below the ſole, correſponds with the principles, and completes the ſyſtem in its whole extent.

Where the lower ſurface of the horny ſole is concave, it muſt follow, that a ſhoe with a flat upper ſurface applied to the projecting cruſt, cannot give preſſure, or indeed touch the horny ſole. To obtain this very important object, nothing more is neceſſary than to allow the lower edge of the cruſt to grow, ſo as to become deeper from the coronet, without removing any other part for a few months, than a ſmall portion of the crumbling dead horny ſole. To make this ſtatement more clear and deciſive; ſuppoſe the proper natural ſubſtance of the horny ſole to be one fourth of an inch, or any given degree of thickneſs; but that, in conſequence of improper treatment, one half of the ſubſtance of the

ſole had been removed, and that, beſides the ſole being thin, the cruſt had alſo been lowered, ſo as to make the edge of the living horny ſole, and the inferior edge of the cruſt, on the ſame level.

I have purpoſely imagined an exceſſively bad caſe, to ſhew that, even with ſuch a hoof, it is very practicable to encreaſe the ſubſtance of the horny ſole to its original healthy thickneſs, and yet to allow the cruſt to project downward below the ſole. As the cruſt, between the intervals of ſhoeing during life, always continues to grow from the coronet downward, the horny ſole alſo encreaſes in thickneſs; and, as the ordinary wear of theſe parts is prevented by the application of a ſhoe, ſo the conſumption of horny ſole and cruſt will be much leſs than the growth; and if no part of the cruſt or ſole were to

be

be afterwards removed, the ſole would ultimately become ſo thick as to be inelaſtic, and, by its preſſure on the ſenſible ſole, occaſion lameneſs. A ſuperabundance of horny ſole is, indeed, one of the moſt frequent cauſes of lameneſs: but where the horny ſole is morbidly thin, and the cruſt not ſufficiently long to project below the ſole, it is requiſite to preſerve both cruſt and ſole for two, three, or four months, according to the degree of diſeaſe; and to obtain a thick ſole and deep cruſt, a bar ſhoe ſhould be employed, raiſed from the heels and quarters, and yet the bar bent upwards, ſo as to meet and reſt on the centre of the frog. By this ſimple practice, as the heels of the ſole and cruſt receive no preſſure from the ſhoe, the growth of horn will much exceed the conſumption, and continue to encreaſe ſo long as this ſyſtem is employed.

A ſole,

A ſole, therefore, that is flat on a level with the cruſt, and too thin for any plain ſhoe, may ultimately be made *concave*, and yet much *thicker in ſubſtance* than where the cruſt and ſole were on the ſame level. If it were requiſite to have the horny ſole even one half of an inch thick; by allowing the cruſt to grow, the ſole might ſtill be made concave; for it certainly does not follow, that concave ſoles muſt of neceſſity be thin ſoles. In a ſtate of nature we ſee the very reverſe, namely, that before the hoof has ever been touched by man, the more concave the lower ſurface of the horny ſole, the thicker is its ſubſtance; and thoſe ſoles which are the moſt flat, and approach the neareſt to the lower edge of the cruſt and bars, are always the thinneſt and weakeſt ſoles. It therefore follows, that Mr. Moorcroft's objection to the College mode of leaving the cruſt

to

to project below the ſole, on the ſuppoſition that the horny ſole is thereby of neceſſity made unnaturally thin, and incapable of protecting the ſenſible ſole from injury, is totally without foundation, as it is very practicable to make the ſame ſole *thick* and *concave*.

The removal of a proper quantity of the horny ſole has been repreſented to be a delicate operation; and, in the hands of common ſmiths, likely to do miſchief. But ſo far from its being either difficult or dangerous, any ſmith capable of paring a hoof, and ſhoeing a horſe in the common manner, cannot fail to be equal to remove a part of the ſole excluſively, with a drawing knife, without taking away any portion of cruſt. And that a certain quantity of the horny ſole, in healthy feet, requires at each

time

time of ſhoeing to be removed, Mr. Moorcroft not only admits, but his directions are ſo explicit and proper, that I cannot do better than adopt his very words.

Mr. Moorcroft obſerves, page 38, line 11, &c. that " The cruſt and the ſole grow faſter than they " wear; and as, after a certain growth, they loſe " their toughneſs, and add an unneceſſary weight " to the limb, it becomes proper to remove the uſe- " leſs portions:" and in page 44, line 11, it is added, that " The ſole ſhould be made ſmooth, by taking " away the dry and crumbly dead horn which ren- " ders the ſurface irregular." This operation is certainly not complicated, but very ſimple. We both declare, that the ſhoe ſhould give no preſſure to the ſole; and, as a general rule, that part of the

ſole,

ſole, in ordinary feet, ſhould be removed at each time of ſhoeing: but here I am obliged to ſtop. I cannot agree farther with Mr. Moorcroft's directions, page 44, line 7, "That the cruſt be reduced "to a level with the edge of the tough or living "ſole, and be left perfectly flat;" and line 18, "That the bars be pared flat, ſo that their ſurface "be left on a level with the ſole." On this point I am at perfect iſſue with Mr. Moorcroft. It forms a moſt eſſential difference between the two ſyſtems of ſhoeing; and I think it my duty to declare moſt plainly and unequivocally, that, in my humble judgment, no one part, even of the common practice of ſhoeing, is more liable to occaſion corns and lameneſs, than that of paring the cruſt and bars to the ſame level with the ſole. If theſe parts are all on the ſame level, there is no form of ſhoe that can be

employed, without being liable to produce corns. Whereas, if the cruſt is more prominent than the ſole, theſe effects may be prevented; and yet a ſmaller proportion of hoof removed than is ordered by Mr. Moorcroft, and leſs than is taken away by common farriers.

The quantity of *ſole* adviſed, by Mr. Moorcroft, to be removed in ordinary caſes, correſponds exactly with my opinion; but after a due proportion of ſole has been taken away, Mr. Moorcroft does not ceaſe to cut, but orders "the cruſt and bars to be reduced "to a level with the edge of the tough or living "ſole, and be left perfectly flat." The advantages to be derived from the projection of the cruſt below the ſole appears ſo obvious, and ſo neceſſary, that I am ſurpriſed there can be two opinions on this im-

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portant ſubject. A ſpace between the ſhoe and ſole is admitted to be neceſſary. Indeed, every groom knows that there ſhould be room for a picker between the ſhoe and ſole; and that, when the ſhoe and ſole come into contact, the horſe is lamed and has corns.

If therefore it be true, that the cruſts of horſes with common hoofs may project downwards below the ſole, and yet the ſole retain its natural thickneſs, then I think it muſt be admitted, even by Mr. Moorcroft himſelf, that the projection of the cruſt below the edge of the ſole, ſo far from producing miſchief, is the very beſt ſecurity againſt corns, and other diſeaſes, which ariſe from the preſſure of the ſhoe on the ſole; and to eſtabliſh this fact, abſtracted

from all arguments and reaſoning on the ſubject, I need only obſerve, that the lower edge of the cruſt of the natural healthy hoof, before it is ever touched by man, projects beyond the ſole; or, in other words, that the healthy ſole of the horſe is naturally concave, and preciſely in that ſtate which I have recommended the art of ſhoeing to imitate.

As nature has made the horny ſole concave, and no doubt of ſufficient ſubſtance for its various functions, it requires no farther inveſtigation to eſtabliſh, that the ſame thickneſs, the ſame concavity, and the ſame relative ſituation of the ſole, in regard to the cruſt, which nature has given, muſt be the beſt and the only true guide for us to follow; nor are the intentions of nature, in thus forming the cruſt to project,

project, and firſt to meet the ground, obſcure. It is obvious, that the wiſdom of this ſtructure is to protect the ſenſible ſole from that ſhock and preſſure to which, if the horny ſole had been on the ſame level as the lower edge of the cruſt, it would have been perpetually expoſed. If the horny ſole, without miſchief to the ſenſible ſole, could have endured the ſame degree of preſſure as the cruſt and bars, then poſſibly they might all have been formed on the ſame level; but ſeeing that nature has conſtructed the hoof otherwiſe, with the cruſt and bars below the ſole, it borders on preſumption, to ſuppoſe that any advantage can be derived by altering the relative ſituation of theſe parts. This, in truth, is ſubverting a law or principle of nature. In the natural hoof, the projecting edge of the cruſt protects the ſole from violence; and when

ſhoes

ſhoes are applied, although the ſole every day becomes ſomewhat thicker, tending to diminiſh the ſpace between the ſhoe and ſole, yet, as the cruſt generally grows in the ſame proportion, the concave ſole of a natural healthy foot will continue of the ſame form. A hoof thus naturally or artificially prepared, will allow of almoſt every poſſible kind of ſhoe to be applied, without defeating the neceſſary principles of ſhoeing.

As the flat ſurface of the ſhoe cannot touch the concave ſurface of the horny ſole, the ſhoe and ſole will be placed at a proper diſtance from each other. The practice and principles will therefore accord; and when the cruſt projects below the ſole, more than is equal to admit a large picker between the ſhoe and the ſole, then, *but not till then*, is there any

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ſuperfluous cruſt to be removed. Without any other examination than the ſimple obſervance of ſeeing that nature has made the lower edge of the cruſt below the ſole, a philoſopher would at once conclude, that the concave part of the hoof was not intended by nature to receive, and therefore could not, without miſchief receive, partial and permanent preſſure; but that the projecting lower edge of the cruſt, being the moſt permanent part, was doubtleſs intended to meet the ground: and as the horny ſole of the natural hoof, both before and after art has been employed, may be preſerved concave, and above the cruſt, without any improper or unnatural diminution of the ſubſtance of the horny ſole, it will follow, that the ſenſible ſole may be as completely protected from ſtones, and indeed be much more ſecure when concave, and above the cruſt, than when the

cruſt

cruſt and ſole are on the ſame level. Groundleſs, therefore, are Mr. Moorcroft's apprehenſions, that the removal of a portion of the horny ſole, by depriving the ſenſible ſole of its natural defence, renders it liable to be bruiſed or wounded by other hard bodies: for as, in truth, the horny ſole may be concave, and yet even thicker than natural, the projection of the cruſt below the ſole moſt certainly cannot expoſe, but protect the ſenſible ſole from injury.

Mr. Moorcroft ſeems to have taken it for granted, that where the ſole is concave, it muſt be of neceſſity thin: but that this poſition is ill founded, and that the ſole, when concave, is beſt protected from all preſſure, I have already, and I hope not unſatisfactorily, endeavoured to prove. Although Mr.

Moorcroft

Moorcroft ſtates, that "This method is obviouſly "brought forward to ſuit the thin heeled ſhoe," yet I am perſuaded, that the ſame ſyſtem is applicable to every kind of ſhoe; and I have the ſatisfaction to ſee, almoſt daily, many horſes ſhod by common farriers, who formerly removed the bars and frog, and applied concave ſhoes, adopt the exact practice I am now recommending. Indeed, a portion of cruſt projecting below the ſole, appears to me not merely the beſt, but the only method to guard effectually, with any ſhoes, the ſenſible ſole from corns and bruiſes.

In my humble opinion, Mr. Moorcroft's ſhoe, when applied to a hoof, where the bars, cruſt, and ſole are flat, and all on the ſame level, muſt often defeat his intentions. I again repeat, we both agree,

that the cruſt and bars ſhould receive the whole preſſure of the ſhoe, and that the ſole ſhould receive none. To accompliſh this deſirable object, Mr. Moorcroft has adopted a ſhoe with the upper ſurface in part concave, and in part flat. The concave ſurface of the ſhoe is intended to be placed immediately oppoſite the ſole, and the flat outer projecting ſurface to reſt on the cruſt. Now, if the object Mr. Moorcroft has in view, that of preſerving the horny ſole from preſſure, could be accompliſhed by this or any other form of ſhoe, while the cruſt, ſole, and bars were flat, and all on the ſame level; that is, if the ſame ultimate effect could in this inſtance be obtained by different cauſes, it would ſcarcely be worth any contention for the preference, although, even in that ſuppoſition, the practice that approaches the neareſt to the operations of nature ſhould be preferred.

ferred. But if it ſhould be demonſtrated, that where the ſole, bars, and cruſt are left flat, and all on the ſame level, that neither Mr. Moorcroft's, or any other ſhoe, can preſerve the ſole from the preſſure of the ſhoe; then that ſyſtem muſt have the preference, which in practice fully completes theſe important principles.

The firſt obvious objection to paring the cruſt on a level with the ſole, is the impracticability of making the flat ſeat of the ſhoe to correſpond, in its whole extent, with the lower edge of the cruſt. The cruſt of moſt horſes is thickeſt at the toe; not ſo thick at the outſide quarter, and thineſt at the inſide quarter. The ſeat of Mr. Moorcroft's ſhoe is made of the ſame degree of breadth at all parts. This defect, however, might be eaſily remedied; but

when the very great variety in the ſize of the feet of different horſes is conſidered, and that feet of every poſſible ſize are ſubject to a great variety in the thickneſs of the cruſt, it is ſcarcely practicable to apply a ſeated ſhoe exactly to fit the cruſt of all horſes. If the ſeat be too narrow for the cruſt, then the ſhoe can have only a partial bearing; and if the breadth of the ſeat exceeds the cruſt, then a part of the ſeat will be oppoſite the ſole, and produce the very effect that the principles of this ſhoe were intended to avoid. The application, therefore, of the ſeated ſhoe in practice, where the ſole, cruſt, and bars are all cut on the ſame level, is not likely, even in the firſt inſtance, to preſs excluſively on the whole cruſt and bars; and ultimately, before the ſhoe is worn out, it muſt very generally happen that the ſole, when placed on the ſame level as the cruſt, will be-

come

come bruiſed by the preſſure of the ſhoe: but that the effects of the ſeated ſhoe may be more clearly underſtood, when applied to a hoof prepared as Mr. Moorcroft recommends, viz. the bars and cruſt to be left on the ſame level as the ſole, it will be neceſſary to premiſe, that the hoofs of horſes, both before and after they have been ſhod, are of a conical form. The upper part of the hoof, at the coronet, forms the apex of the cone, and is about one third leſs in diameter than the bottom of the cruſt that receives the nails of the ſhoe; and yet the cruſt, at this broad diameter of the hoof, came originally from the coronet; that is, the cruſt in its whole deſcent becomes gradually wider. A ſhoe, therefore, that exactly fits the lower edge of the cruſt when firſt applied, or that is even larger than the wide diameter of the hoof, and projects over the

lower

lower edge of the cruſt at the heels and quarters, will, before the expiration of the month, be ſmaller than the wide diameter of the hoof, and within the cruſt. In every inſtance, the lower edge of the cruſt, in contact with the upper ſurface of the ſhoe at the heels and quarters, will become wider from ſide to ſide; and in every inſtance the ſhoe will not become wider, but remain exactly of the ſame diameter. As the one then is always growing and expanding, and as the other is neither growing or expanding, it is evident, that if both exactly fit when the ſhoe is firſt applied, they can remain in that ſituation only ſo long as the parts continue ſtationary. If the cruſt expands as it deſcends, and the width of the ſhoe remains unaltered, the ſame part of the ſhoe that is in contact with the cruſt when firſt applied, cannot, in any inſtance, continue in the ſame place

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even for one week. Theſe facts ſhould be remembered, while I repeat Mr. Moorcroft's directions, that the lower edge of the cruſt and bars are to be made perfectly flat, on a level with the edge of the tough or living ſole; and then a ſhoe to be applied with a flat projecting ſurface to fit the cruſt, and a concave ſurface oppoſite the ſole.

I have already pointed out the great difficulty of making the ſeat of the ſhoe exactly to correſpond with the lower edge of the cruſt; but if even this point could be in all caſes eaſily obtained, as there is no hoof that does not grow, or any ſhoe that does grow, ſo there can be no caſe where the flat ſeat of the ſhoe could remain wholly oppoſite the cruſt. If the inner edge of the ſeat of the ſhoe mathematically correſponds with the inner edge of the cruſt

when

when firſt applied, which is the intention and principle of the ſeated ſhoe, then exactly as much as the lower edge of the hoof expands, will the flat ſeat of the ſhoe be oppoſite the ſole. The ſole being flat on a level with the cruſt, and the ſeat of the ſhoe being flat, theſe parts which were intended to be always ſeparated, muſt neceſſarily touch each other.

The very principle of Mr. Moorcroft's ſhoe, and the ſole intention of thoſe who firſt propoſed a ſeated ſhoe, was, that the flat ſeat was always to be in contact with the cruſt, and never oppoſite the ſole; and where the hoof is dead, and the ſeat adapted to the width of the cruſt, this principle may be completed by Mr. Moorcroft's practice. But I will venture to affirm, that ſo long as the lower edge of the

cruſt

cruſt continues to expand, and ſo long as ſhoes are made of materials that neither expand nor grow, it muſt follow, that the ſurface of iron in contact with the hoof, muſt, in all caſes, between the intervals of ſhoeing, change its ſituation: that is, the ſeat of the ſhoe, although oppoſite the cruſt when firſt applied, muſt inevitably, in part or altogether, before the ſhoe is worn out, be placed oppoſite the ſole; and if the ſurface of the iron and the ſurface of the horny ſole are both flat, and both placed oppoſite on the ſame level, there is no problem in Euclid more clear, than that the ſhoe and ſole, which were intended to remain ſeparated, muſt come into contact. The practice, therefore, of making the bars, cruſt, and ſole, all on the ſame level, is not only *unnatural*, but it defeats the very object for which the ſeated ſhoe was made. Where the cruſt, ſole, and bars are preſerved

on the ſame level, there is no form of ſhoe that can be made to reſt, during the wear of the ſhoe, excluſively on the cruſt; but where the cruſt, ſole, and bars are permitted to retain their relative ſituations, namely, the cruſt and bars to project below, and the ſole to remain concave above, there is ſcarcely any form of ſhoe that is not capable of preſerving the ſole free from preſſure or corns. It is therefore of much greater importance to put the hoof in a proper ſtate to receive the ſhoe, than to employ the beſt ſhoe that can be made without this precaution, in as much as there is no form of ſhoe, where the ſole and cruſt are on the ſame level, that can be ſafely applied. Whereas, if the hoof be prepared in the ſame manner that nature has thought proper to adopt, there is ſcarcely any ſhoe likely to bruiſe the ſole or produce corns.

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The ſeated ſhoe, when the hoof is properly prepared, is neither better nor worſe than a ſhoe with its whole upper ſurface flat; for where the cruſt is allowed to project in a proper degree below the ſole, any ſhoe may be applied to the cruſt without preſſure to the ſole. The great expence, therefore, of making a ſeated ſhoe, and the application of it to a foot properly prepared, is uſeleſs; and where the cruſt, bars, and ſole are on the ſame level, this ſhoe cannot fulfil the intentions for which it was formed, but will moſt certainly be liable to produce the very effect it was made to prevent. Nevertheleſs, although a ſeated ſhoe is not well adapted to prevent preſſure to the ſole, yet, if the expence of manufacturing this kind of ſurface was not conſiderable, and the nail holes could be properly made without difficulty; this ſurface oppoſed to the ground,

but (never to the ſole) would be a good form for ordinary purpoſes.

A ſhoe, with a flat projecting outer edge on its lower ſurface, in as much as it correſponds to the lower edge of the cruſt, is admirably calculated to pierce the ground, while the remaining portion of the ſhoe, like the ſole, being concave, is well adapted to the convexity of the earth. Mr. Moorcroft's ſhoe reverſed, would preſent a ſurface to the ground very ſimilar to the natural hoof without a ſhoe; and therefore, if it could be made with the ſame facility as the common ſhoe, and the nail holes with equal accuracy, ſo far as regards the form of the lower ſurface, for common purpoſes, I think, it would be an improvement, but not neceſſary to preſerve the foot in health.

In

In regard to thin heeled ſhoes, and the frog receiving preſſure, I have already, in the preface, endeavoured to reply in ſome degree to the objections and miſrepreſentations which have been made againſt that ſyſtem. But the compariſon Mr. Moorcroft has drawn between a horſe ſhod, as recommended, with thin heeled ſhoes, and a man wearing ſhoes thick at the toe and thin at the heel, is not applicable to the caſe; and the remark is certainly very different from the general acuteneſs of Mr. Moorcroft's obſervations. If the heel of the human ſubject could encreaſe in depth and in ſubſtance, in the ſame manner as the human nail, or the hoofs of horſes, then with perfect ſafety might the heel of the ſhoe be made thin, and the toe thick, in proportion as the fleſhy heel increaſed in ſubſtance.

Mr.

Mr. Moorcroft obſerves, page 30, line 21, " That " it is more advantageous to the tread of man, that " his ſhoe ſhould at leaſt be as thick at the heel as " at the toe." If the ſhoes were made three times as thick at the toe as at the heel, he adds, " Is it " not likely that common ſenſe would reject ſuch " practice as unnatural and abſurd? It may eaſily " be imagined what would happen to foot ſoldiers " on a march," &c. I am ready to admit, with Mr. Moorcroft, that, for the human ſubject, common ſenſe would reject this practice. But I cannot agree with the ſame Author, " That it is not ſtraining the " argument to compare, in this point of view, the " foot of a man with the foot of the horſe." There is no analogy whatever between the bottom of a hoof that is hourly encreaſing in ſubſtance, and, from the protection of the ſhoe, is not wearing equal to its growth;

growth; and the heel of the human foot, which neither enlarges or diminiſhes in ſubſtance, but is regulated by the ſame laws as other ſoft parts.

The only juſt compariſon that can be made between the hoof, and any part of the human ſubject, is the nail. The nails, like the hoof, are of a horny ſtructure, and, through life, are always growing. If, therefore, it was thought requiſite to cut the middle or toe of the nail ſhort, and preſerve the ſides or heels of the nail long, this might be accompliſhed not only without miſchief, but in the feet with very great advantage. Indeed, this practice is very neceſſary in the human ſubject, to prevent the ſides of the nail from growing into the fleſh, which is a diſeaſe not very diſſimilar to a contraction of the ſides of the hoof of the horſe.

I mention

I mention the growth of the nail, however, more particularly to ſhew its analogy to the growth of the cruſt; and, as the nail may be preſerved long at one part, and ſhort at another part, ſo the heels of the hoof may be preſerved high, and the toe ſhort; and, by adopting this very ſimple practice, a ſhoe may ultimately be applied with thin heels, and yet the depth of cruſt and ſhoe united, from the coronet to the toe, may be diminiſhed, while the depth of cruſt and ſhoe, from the coronet to the lower part of the heels, may be encreaſed.

The hoof, during life, I have repeatedly obſerved, is always growing; and therefore if a portion of horn be removed, equal to that which has been depoſited at the toe of the hoof, and if no portion whatever be removed from the heels, then, without ſhoes, the

relative

relative proportions being altered, the muſcles that ſupport the heels would have leſs weight to ſuſtain than before. This practice might be encreaſed to an improper degree, and the weight of the animal ſupported ſo much by the coffin, and ſo little by the navicular bone, as to occaſion inconvenience, and even lameneſs. The application, therefore, of the thin heeled ſhoe, when properly applied, can give neither more or leſs weight to the flexor muſcles; but as the human ſubject has no organization to depoſit any additional quantity of fatty ſubſtance to elevate the heel, and to make up in height what may be removed from the heel of the ſhoe, it is obvious, that there is not ſufficient analogy between the two organs to juſtify a compariſon: beſides, the heels of the horſe are placed behind the bones of the foot,

and therefore ſupport but a very ſmall proportion of the ſuperincumbent weight. It is nevertheleſs true, that there are many hoofs not in a fit ſtate to receive a thin heeled ſhoe, and this has been urged as an objection to the ſhoe itſelf; but, on the ſame principle, great objection might be made to every poſſible kind of ſhoe. A bar ſhoe, or a ſhoe turned up at the heel, is well adapted for certain purpoſes, and for certain feet; and it is no objection to the merits of theſe ſhoes, that they may, when improperly applied, occaſion miſchief. No inſtrument or machine can ever be well adapted for various and oppoſite functions. I have repeatedly ſtated, that where the heels of the hoof are not ſufficiently high, the remedy is very ſimple.—The ſhoe with thin heels is *not* to be employed.

Mr.

Mr. Moorcroft admits, "That the frog has ſeve-
"ral offices to perform, among which, that of break-
"ing the force of the blow, when the foot ſtrikes
"violently againſt the ground, is one of the moſt
"important; and, for the due performance of this
"function, its flexibility and ſpongy nature are moſt
"admirably calculated." I have nothing to offer againſt this opinion, for it perfectly accords with every thing I have advanced on the ſtructure and œconomy of the horny and ſenſible frog; but I would aſk, how it is poſſible for the frog *to break the force of the blow* if it does not touch the ground? I have already endeavoured to prove, that the horny frog never, in the ſmalleſt degree, deſcends, ſo that, unleſs the frog is placed on a level with the heels of the ſhoe, on all ſmooth ſurfaces, it cannot meet the

ground, and therefore its functions would not be performed. That the frog may, however, receive too much preſſure, I moſt readily admit. It was not intended to project beyond the lower part of the hoof or ſhoe, and receive the whole, or even the firſt impreſſion from the ground; but when placed on a level with the ſhoe, it does not, as Mr. Moorcroft ſuppoſes, "acquire a degree of hardneſs equal to that of any "other part of the hoof." On the contrary, it will be found that part, or the whole of thoſe frogs which have been moſt raiſed from the ground, are very generally the *hardeſt* and moſt inelaſtic in their ſtructure. Indeed, even in thoſe caſes where the heels of the frog are ſoftened by the moiſture iſſuing from the ſenſible frog, as in thruſhes, it will be found, that the ſolid anterior part of the frog is extremely hard

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and inelaſtic, while thoſe frogs which have been moſt accuſtomed to preſſure are the moſt expanded, moſt elaſtic, and the moſt healthy.

The horny frog, if not contracted or raiſed above the ground, is ſeldom or ever hard or inelaſtic; for where the external frog has been much expoſed to preſſure from below, its internal cavity is preſerved expanded, and no lateral preſſure is given to the ſides of the ſenſible frog: but when the internal cavity of the horny frog becomes diminiſhed, the ſides of the ſenſible frog become ſqueezed and inflamed. In proportion to the degree of inflammation of the ſenſible frog, the external frog is heated; and, from this morbid accumulation of heat, the horny frog ſoon becomes dry and inelaſtic. That the frog is naturally, and ſhould always remain flexible,

and

and of a ſpongy nature, for the due performance of its functions, is certainly true; for, when hard and inelaſtic, it frequently gives a great degree of concuſſion to the whole foot, and is leſs capable of aſcending and expanding the ſide cartilages. Theſe are the caſes where thin heeled ſhoes, ſuddenly applied, will certainly produce uneaſineſs to the animal, and often lameneſs. The frog having loſt its elaſticity, has, at the ſame time, in a great degree loſt its uſe; and unleſs a radical cure be attempted by raſping the quarters, applying moiſture to the hoof, reſt, &c. it is better to perſevere in the ſame ſhoes the horſe has been accuſtomed to wear.

It ſhould nevertheleſs be underſtood, that although the horſe, under theſe circumſtances, may for the preſent go better without, than with preſſure to the frog,

frog, yet the contraction and hardneſs of the frog has been occaſioned by the want of preſſure from the ground. I am therefore completely at iſſue with Mr. Moorcroft as to the cauſe of this defect. If it were a fact, that thoſe frogs, which are the moſt prominent and moſt expoſed to preſſure, are the moſt hard and brittle; and that thoſe frogs which are raiſed above the preſſure of the ground are the moſt elaſtic and healthy, then I ſhould certainly give up the point, and attribute preſſure as the cauſe of hardneſs in the frog, and deſtructive of its ſtructure and functions.

But I have examined the frogs of many hundred horſes, and I have uniformly found, that thoſe were the moſt elaſtic that had been accuſtomed to preſſure, while thoſe which had been raiſed above the

ground

ground were often hot and contracted, and, in ſuch caſes, always hard and inelaſtic. Indeed, it is not conſiſtent with the wiſdom and laws of nature, that ſhe ſhould have formed an organ, elaſtic in its ſtructure, and placed in a ſituation much expoſed to preſſure, if that preſſure had been pernicious, and altered its original formation. Experience, therefore, confirms what might juſtly be inferred from the ſituation, the natural form and ſtructure of the frog, that preſſure was originally intended, and therefore is neceſſary to be applied to that organ, to preſerve its elaſtic ſtructure and œconomy.

I cannot, however, better conclude theſe obſervations, than by repeating, that although the frog, ſo far as its own functions are concerned, is benefited by preſſure, yet neither a ſhoe with thin or thick heels

heels, or any other form of ſhoe, can ever be ſucceſsfully applied in all caſes, and for all horſes employed for every purpoſe. Beſides, when a habit has been long eſtabliſhed, however deſtructive to a ſingle organ, or to the whole machine, any violent alteration is generally productive of miſchief, and ſometimes even of danger. A man long accuſtomed to take much ſpirits or poiſon, as laudanum, would die from being deprived ſuddenly of the power of indulging his habit. A horſe, habituated to reſt or exertion, cannot bear the converſe without danger of diſeaſe: indeed, to uſe a common expreſſion—"habit is a ſecond nature;" and in no inſtance is this principle more applicable than to the frog of the horſe, naturally formed elaſtic in its ſtructure, and deſtined to receive preſſure; but when habit has altered its ſtructure, and produced diſeaſe, then the

ſame pernicious habit cannot be ſuddenly changed without inconvenience. Nevertheleſs, in regard to the ſole, whatever may have been the habit, it ſhould be adopted as an invariable principle in every country, and in every age, that this organ is never to receive the preſſure of the ſhoe, and that the beſt and only ſecure ſyſtem to accompliſh this deſirable object, is not, as Mr. Moorcroft recommends, to make the bars, cruſt, and ſole, all on the ſame level, but always to leave the whole lower edge of the cruſt, as nature has directed, projecting below the ſole.

EXPLA-

EXPLANATION OF THE PLATES.

PLATE I.

FRONT VIEW OF THE BONES OF THE FOOT, &c.

1, 2, 3.—Three cavities on the upper ſurface of the large paſtern bone, to articulate with three correſponding convexities in the lower head of the cannon bone.

a.—The centre of the large paſtern bone.

4, 4.—The lateral parts of the upper head of the large paſtern bone, rather rough for the attachment of ligaments.

5, 5.—The lateral rough ſurfaces of the lower head of the large paſtern bone, which alſo receive the inſertion of ligaments.

6.—The centre of the anterior and lower ſurface of the large paſtern bone, to which the extenſor tendon is attached.

b.—The cartilage covering the lower end of the large paſtern bone.

7, 7.—Two concavities in the lateral and upper ſurfaces of the

ſmall

ſmall paſtern bone, to fit the extremity of the inner and outer head of the large paſtern bone.

c.—A concavity in the centre of the upper ſurface of the ſmall paſtern bone, covered by cartilage to articulate with the centre of the lower ſurface of the large paſtern bone.

d.—The ſmall paſtern bone.

e.—The lower cartilage of the ſmall paſtern bone.

f.—The upper ſurface of the navicular or nut bone, covered by cartilage, and ſlightly concave, to receive the poſterior ſurface of the lower head of the ſmall paſtern bone.

g, g.—The upper concave ſurface of the coffin bone, that articulates with the ſmall paſtern bone, covered by cartilage, and forming part of the coffin or foot joint.

h.—The anterior proceſs of the coffin bone for the inſertion of the extenſor tendon.

I, I, I, I.—A ſmall groove on each ſide of the coffin bone for the reception of an artery; and a ſmall branch of a nerve to be diſtributed to the ſenſible laminæ, and finally to enter the inner ſubſtance of the coffin bone.

i, i.—Two ſmall lateral depreſſions in the heels of the coffin bone, which receive correſponding projections of the ſide cartilages.

k, k.—Two lateral proceſſes of the heels of the coffin bone, received into two correſponding cavities in the ſide cartilages.

L, L.


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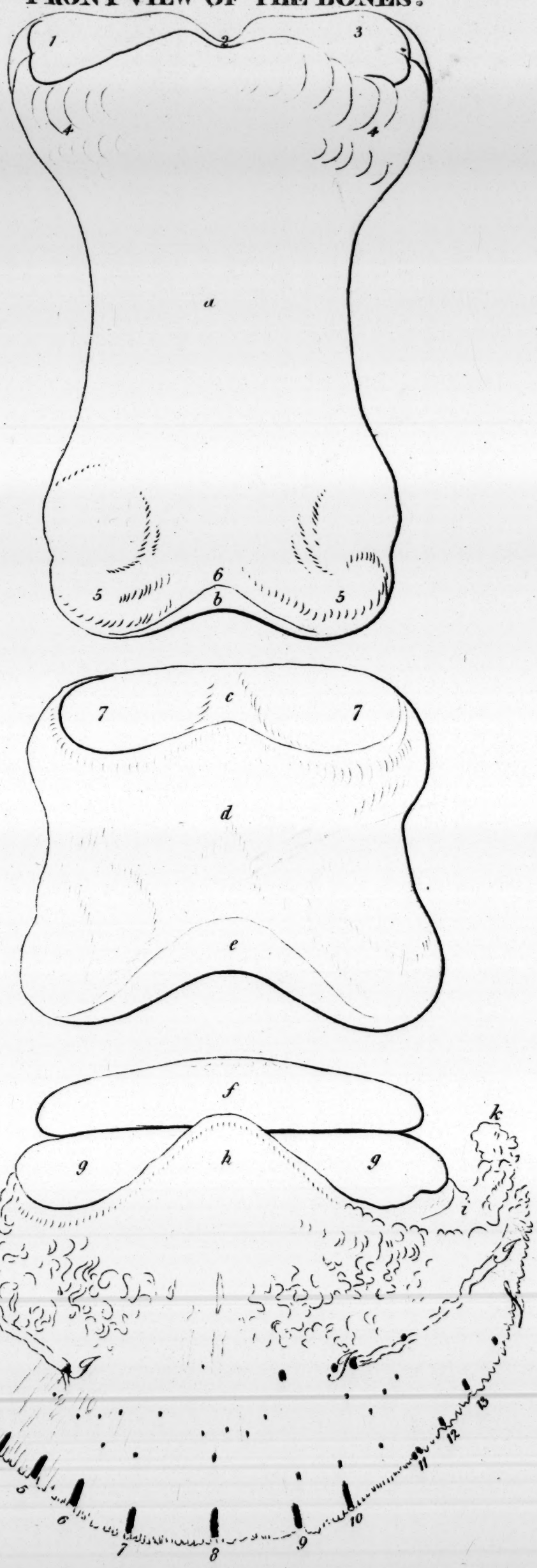
FRONT VIEW OF THE BONES.



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L, L.—The lateral and inferior ſurface of the heels of the coffin bone, very porous, for the tranſmiſſion of numerous blood veſſels.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13.—Thirteen foraminæ in the outer and inferior edge of the coffin bone, for the tranſmiſſion of arteries, which paſs over the edge of the coffin bone to the ſenſible ſole, on the under ſurface of the coffin bone.

PLATE

PLATE II.

BACK VIEW OF THE BONES.

a, a.—The poſterior ſurface of the two ſeſamoid bones covered by cartilage.

B.—A ſpace between the ſeſamoid bones, and the centre of the upper and back part of the large paſtern bone, occupied by ligament.

b, b, b.—A rough concave ſurface on the back part of the large paſtern bone for the inſertion of a flat deep ſeated ligament, connected above to the lower edges of the ſeſamoid bones.

c.—The lower ſurface of the large paſtern bone covered by cartilage.

d.—The upper ſurface of the ſmall paſtern bone covered by cartilage.

e.—The body of the ſmall paſtern bone.

f, f.—The lower ſurface of the ſmall paſtern bone covered by cartilage.

2, 2, 2.—The poſterior and upper rough edge of the navicular bone for the attachment of ligament.

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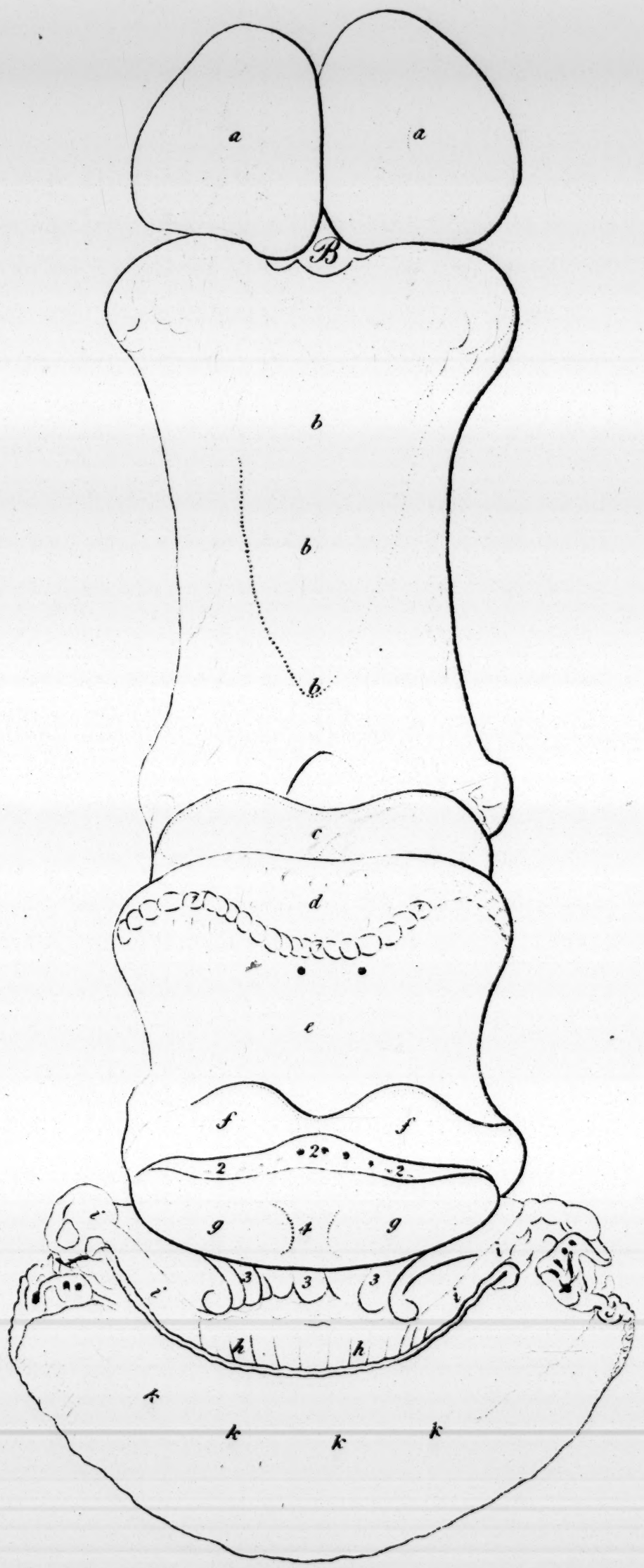
BACK VIEW OF THE BONES.



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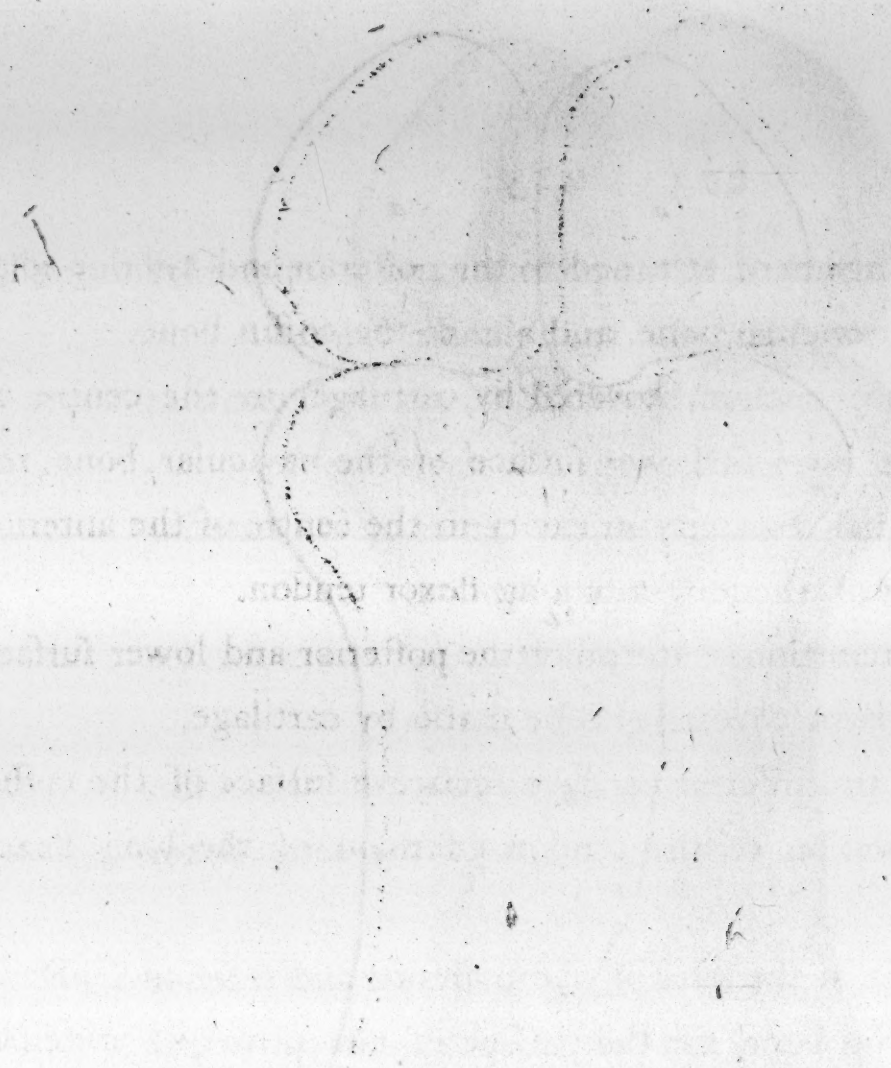

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3, 3, 3.—A ligament attached to the poſterior and inferior edge of the navicular bone, and alſo to the coffin bone.

4.—A ſmall projection, covered by cartilage, in the centre of the poſterior and lower ſurface of the navicular bone, received into an equal concavity in the centre of the anterior and lower ſurface of the long flexor tendon.

g, g.—The remaining portion of the poſterior and lower ſurface of the navicular bone covered alſo by cartilage.

h, h.—The poſterior and inferior concave ſurface of the coffin bone, for the inſertion of the tendon of the long flexor muſcle.

i, i, i, i.—Two grooves in the ſides of the poſterior and inferior ſurface of the coffin bone, for the paſſage of two principal arteries to the internal part of the coffin bone.

k, k, k, k.—The anterior and inferior concave ſurface of the coffin bone, for the attachment of the ſenſible ſole.

L, L.—The lower ſurface of the heels of the coffin bone, very porous, for the tranſmiſſion of arteries from within the coffin bone to the ſenſible ſole.

PLATE

PLATE III.

SIDE VIEW OF THE EXTENSOR TENDON LIGAMENTS.

A.—The lower portion of the cannon bone.

B.—A long extenſor ligament, which takes its origin from the outer ſurface of the ligaments of the knee, a little below which it receives the inſertion of a ſmall extenſor muſcle, and is finally attached to the anterior and upper part of the large paſtern bone, on the outer ſide of the extenſor tendon.

c, c, c.—The tendon of the extenſor muſcle, inſerted into the anterior ſurface of the large and ſmall paſtern bones, and ſuperior proceſs of the coffin bone under the coronary ligament.

d, d, d.—The lower portion of the upper flexor ſuſpenſory ligament of the ſeſamoid bones, which divides into two parts at the large paſtern joint, to paſs over the outer and inner edge of the navicular bones, and inſerted into the extenſor tendon near the middle of the large paſtern bone.

E.—One of the ſeſamoid bones.

e, e.—The large paſtern bone.

f, f.—A lateral ligament attached to the lower head of the large and upper head of the ſmall paſtern bone.

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PLATE III Vol.II.

SIDE VIEW OF THE EXTENSOR TENDON, LIGAMENTS &c.

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F.—The lower head of the ſmall paſtern bone covered by cartilage: the ligament ſurrounding this part has been removed, to give a ſide view of the coffin joint.

G.—A lateral ligament attached to the heel of the coffin bone, and inferior head of the ſmall paſtern bone.

g, g, g.—A ſide view of the coronary ligament which ſurrounds the coffin joint and lateral cartilages, and inſerted into the heels of the ſenſible frog. This ligament has been ſtripped of its vaſcular covering.

H, H.—The coffin bone.

I, I, I.—The external ſurface of one of the lateral cartilages below the coronary ligament, ſtripped of its vaſcular laminæ. The lower edge of this cartilage is united horizontally with the correſponding inferior cartilage.

K, K, K.—The inner ſurface of the oppoſite the ſide cartilage, lined with fat and cellular membrane: a portion of the outer ſide cartilage being removed to give this view.

PLATE IV.

FIG. I.

BACK VIEW OF THE FLEXOR TENDONS AND LIGAMENTS.

a, a, a, a.—The tendon of the flexor perforatus muſcle, above and below the fetlock joint, cut open, to ſhew the ſheath. The flexor perforans has been removed.

b, b.—The poſterior ſurface of the perforatus tendon, forming a complete circular ſheath at theſe parts.

B, B, B.—The lower part of the ſheath much thinner than the upper part, attached to the ſuperior head of the ſmall paſtern bone, and lower head of the large paſtern bone.

c, c.—The poſterior ſurface of the ſeſamoid bones covered by cartilage, over which the flexor perforans is paſſing.

2, 2.—A ligament which unites together the inner edges of the two ſeſamoid bones.

d, d.—The poſterior and inferior ſeſamoid ligament, broad at the upper part, and narrow in the middle; attached to the lower edge of the ſeſamoid bones, anterior to the ſheath, and inſerted into the upper and back part of the ſmall paſtern bone.

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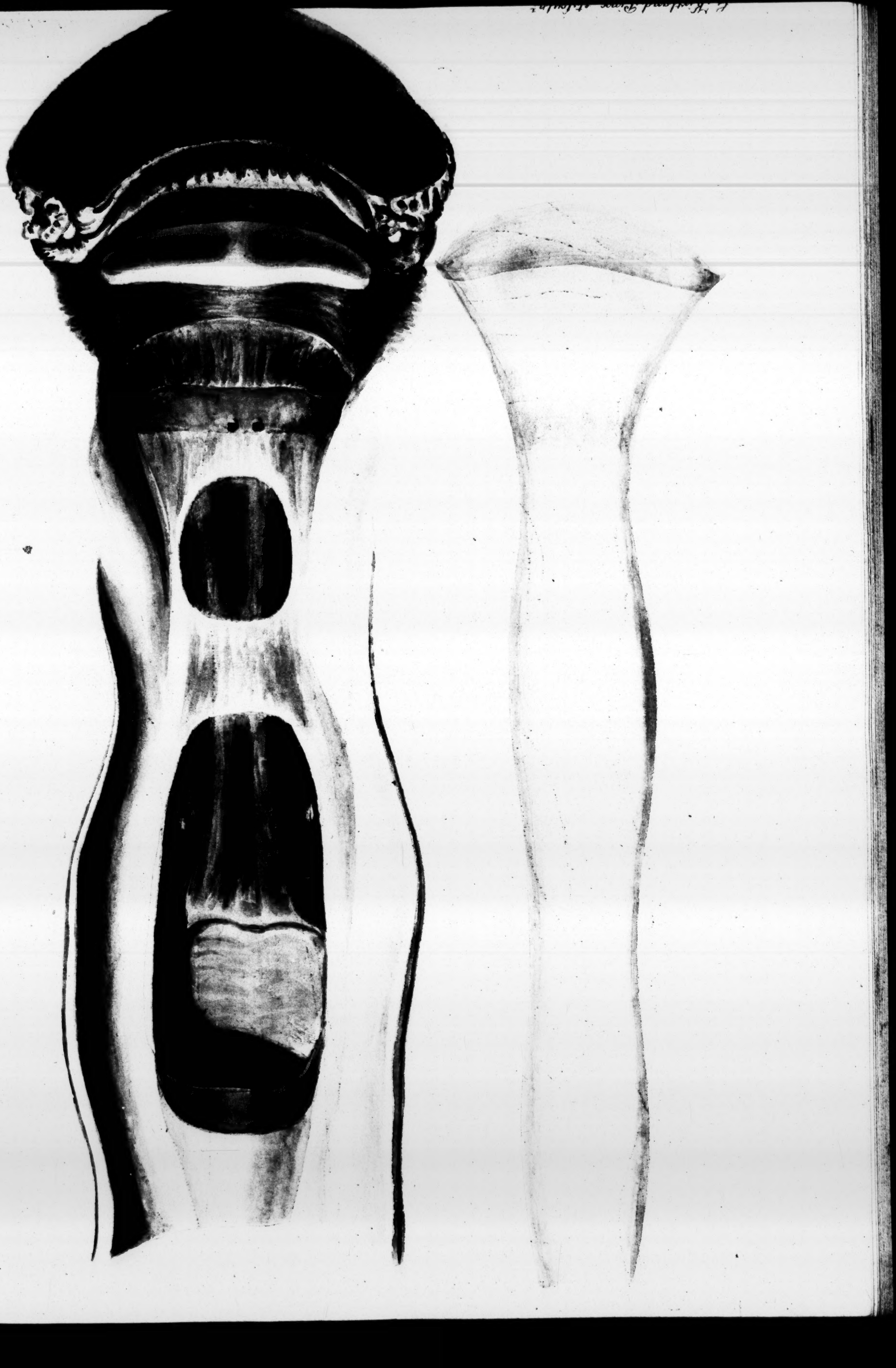
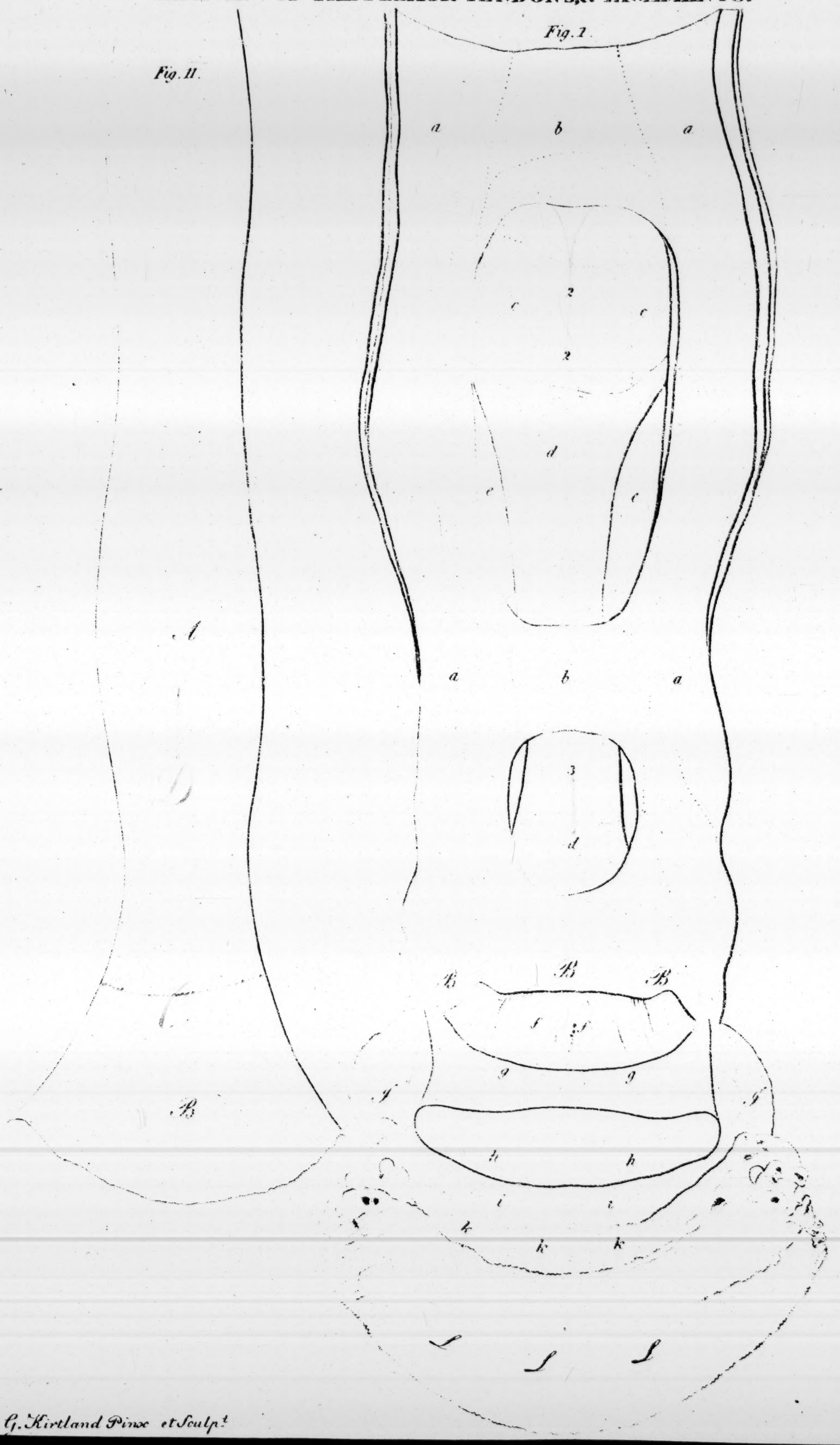


BACK VIEW OF THE FLEXOR TENDONS, & LIGAMENTS.



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G.R.
III.

3.—A flat portion of elaſtic cellular membrane, attached to the inferior ſeſamoid ligament, and to the anterior ſurface of the perforans tendon.

e, e.—The ſhort inferior ſeſamoid ligament, attached to the inner and lower edge of the ſeſamoid bones, and to the upper and back part of the large paſtern bone.

f, f.—A ligament attached to the anterior ſurface of the flexor perforans tendon, to the middle of the back part of the ſmall paſtern bone, and connected below with the ſuperior ligament of the navicular bone.

g, g.—A ligament attached to the whole of the upper edge of the navicular bone, and to the back part of the flexor tendon, and alſo to the lower edge of the laſt ligament, f, f.

h, h.—The lower ſurface of the navicular bone covered by cartilage, over which the perforans tendon is paſſing.

I, I.—Two ligaments attached to the ends of the navicular bone and inner ſurface of the ſide cartilages.

i, i.—A ligament attached to the whole of the inferior edge of the navicular bone, and to the lower ſurface of the coffin bone, poſterior to the inſertion of the flexor perforans tendon.

k, k, k.—A concave ſurface anterior to the attachment of the inferior ligament of the navicular bone, for the inſertion of the tendon of the flexor perforans.

L, L, L.—The inferior and anterior ſurface of the coffin bone, for the attachment of the ſenſible ſole.

PLATE IV.

FIG. II.

A.—The flexor perforans tendon taken out of the ſheath, and ſeparated from its attachments.

B.—The broad part of the flexor perforans tendon, being expanded at its termination, to correſpond with the concave ſurface of the coffin bone.

C.— The ſurface of attachment for the upper ligament of the navicular bone.

D.—The ſurface of attachment for a ſmall portion of elaſtic cellular membrane.

PLATE V.

SECTION OF THE BONES, HOOF, &c.

A.—The lower head of the cannon bone.

B.—The lateral edge of one of the ſeſamoid bones.

C.—The large paſtern bone.

D.—The ſmall paſtern bone.

E.—The navicular bone.

F.—The coffin bone.

G.—A large foramen within the ſubſtance of the coffin bone, for the paſſage of a large circular artery.

H.—A ſide view of one of the ſenſible laminæ, which forms the lateral ſurface for the attachment of one of the horny laminæ.

I.—A ſide view of one of the horny laminæ.

K.—A ſection of the ſmooth cruſt, to ſhew its thickneſs on the outſide of the horny laminæ.

3.—The concave coronary ring of the cruſt above the laminæ, much thinner than the laminated cruſt below.

L.—The ſenſible ſole thickeſt at the toe, attached to the coffin bone above, and horny ſole below.

M.—The horny ſole.

N, N, N.

N, N, N.—The fatty ſubſtance of the ſenſible frog, being compoſed of oil, elaſtic cellular membrane, and cartilage.

O.—The vaſcular ſecreting ſurface of the ſenſible frog.

P.—A cleft in the horny frog.

Q.—The ſubſtance of the anterior part of the horny frog.

R.—A ligament attached to the coffin bone, and lower edge of the navicular bone.

S.—The tendon of the flexor perforans inſerted into the coffin bone, immediately anterior to the inſertion of the laſt named ligament. The lower ſurface of this tendon is, in part, in contact with the upper ſurface of the ſenſible frog, and in part attached to the upper ſurface of the inferior cartilages. A portion of the upper ſurface of this tendon moves over the cartilaginous covering of the navicular bone, but is not united to any part of that bone.

T.—The upper ligament of the navicular bone, being inſerted into the back and thickened part of the tendon of the flexor perforans.

t.—A ligament attached to the laſt deſcribed ligament, and inſerted into the back part of the ſmall paſtern bone.

V.—The termination of the upper ſuſpenſory ligament of the ſeſamoid bones.

U.—The ſhort and inner ligament of the ſeſamoid bones, attached to the back part of the large paſtern bone, and to the lower and inner edge of the ſeſamoid bones.

W. W.


G R
III

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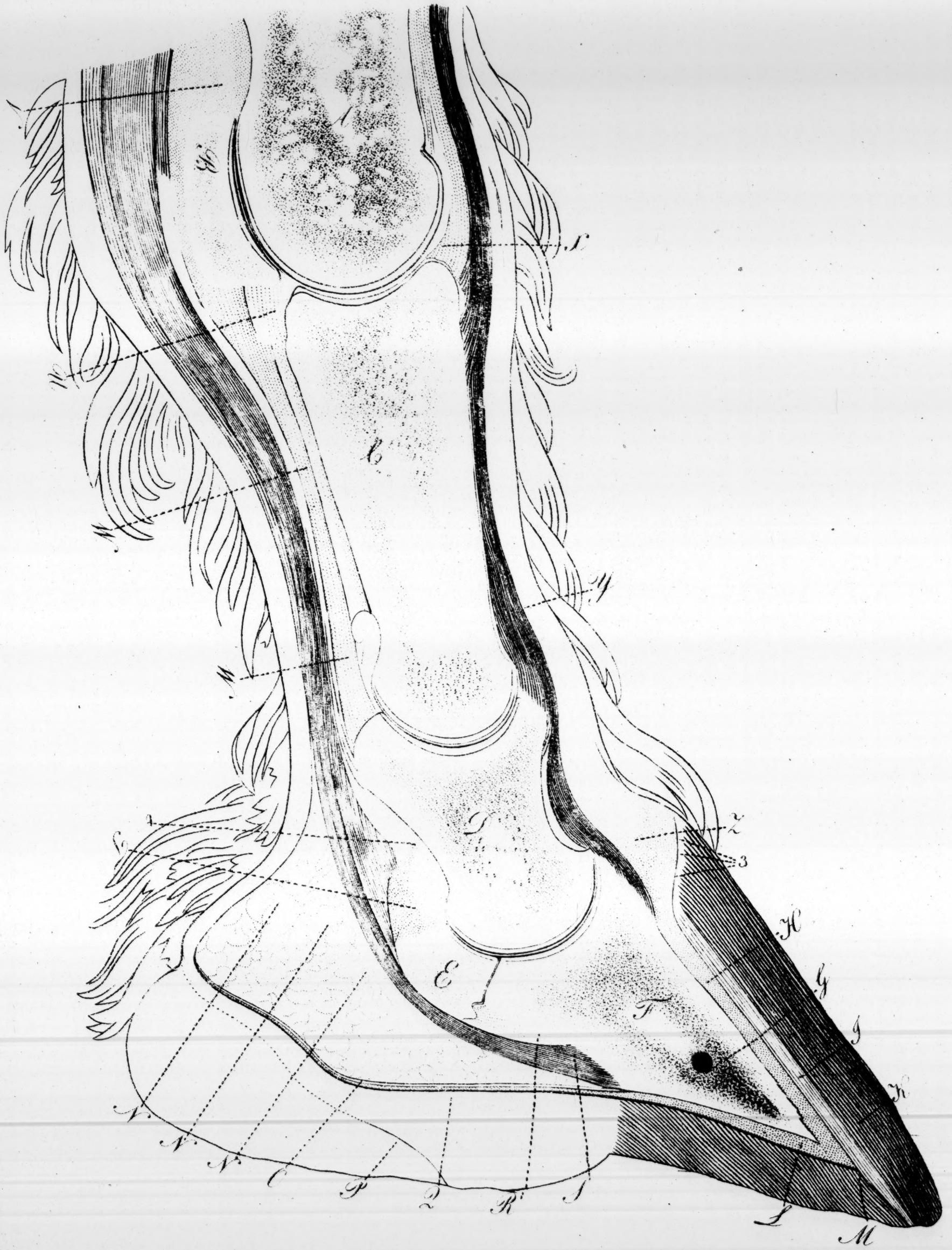
PLATE V. Vol. II

SECTION OF THE BONES, HOOF &c.



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W. W.—The outer and inferior long ſuſpenſory ligament of the ſeſamoid bones, inſerted into the upper and poſterior projecting head of the ſmall paſtern bone.

X.—A long extenſor ligament, attached below to the anterior and upper part of the large paſtern bone, and above to the outer part of the knee.

Y.—The extenſor tendon inſerted into the large paſtern, ſmall paſtern, and coffin bone.

Z.—The glandular covering of the coronary ligament that ſecretes the ſmooth and horny cruſt.

PLATE

PLATE VI.

A SIDE VIEW OF THE MUCOUS BAGS, &c.

A.—The lower head of the cannon bone.

b, b, b.—Three circumſcribed mucous capſules, or bags, between the poſterior and inferior head of the cannon bone and the lower portion of the upper ſuſpenſory ligament, containing a quantity of mucus, but enlarged in conſequence of exceſſive labour, forming what are commonly termed wind galls. Theſe bags have been termed wind galls, from the ſuppoſition that they contained air, and a ſuppoſed reſemblance to a vegetable ſubſtance.

c.—A ſide view of the lower half of the upper ſuſpenſory ligament, attached to the edge of the ſeſamoid bones.

D.—A continuation of the ſame ligament which paſſes obliquely forward and downward, to be connected with the extenſor tendon.

d, d, d.—Three enlarged mucous bags between the ſuſpenſory ligament and the perforans tendon.

e, e, e.—The perforans tendon between the ſuſpenſory ligament and the tendon of the perforatus muſcle.

f, f.—Two mucous bags, in a leſs degree diſtended, between the flexor


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PLATE VI. Vol. II.

A SIDE VIEW OF THE MUCOUS BAGS

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flexor perforans and flexor perforatus tendons above the ſheath.

g, g.—The perforatus tendon above the large paſtern joint.

H, H, H.—The external ſurface of the perforatus tendon, forming a ſheath oppoſite and below the large paſtern joint, to receive within its cavity the tendon of the flexor perforans.

N. B. The whole of the mucous capſules are repreſented in a morbid ſtate, as wind galls, to give a better idea of their ſituation and functions.

PLATE VII.

SIDE VIEW OF ONE OF THE SIDE CARTILAGES, IN PART COVERED BY SENSIBLE LAMINÆ, &c.

A, A, A.—The upper portion of cartilage naturally covered by ſkin, but here removed, to ſhew the whole extent of the upper irregular edge of the cartilage above the hoof.

B, B, B.—The vaſcular convex covering of the coronary ligament that ſecretes the cruſt or wall. The coronary ligament lies immediately under the glandular ſtructure, and ſurrounds the coffin joint (See Plate III. g, g, g.) and both cartilages; but in this plate the vaſcular covering of the ligament is intended to be ſhewn.

C, C, C.—The vaſcular laminæ which are attached to the lower edge of the coronary ligament, and to the external ſurface of the ſide cartilages.

D.—A lateral ligament attached to the anterior edge of the ſide cartilage below the ſkin, and inſerted into the lateral edge of the anterior proceſs of the coffin bone, to aſſiſt in preſerving one of the ſide cartilages in its ſituation.

E, E, E.—A ſide view of the coffin bone ſtripped of its vaſcular laminæ, to mark out preciſely the quantity of laminæ attached to the coffin bone, and to each of the ſide cartilages. This plate alſo deſcribes the extent of the ſide cartilage and laminæ behind the coffin bone.

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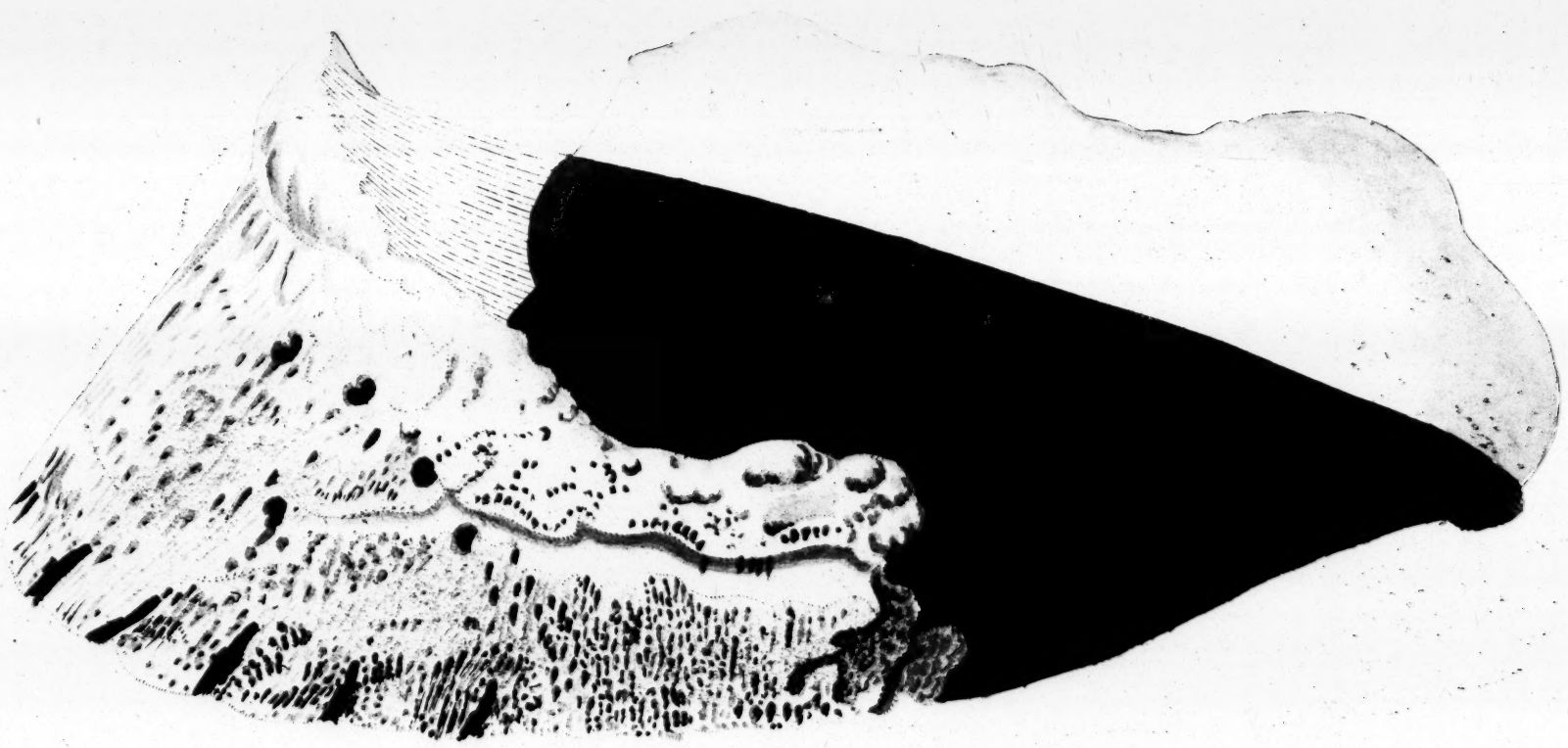

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SIDE VIEW OF THE CARTILAGE IN PART COVER'D BY LAMINÆ.

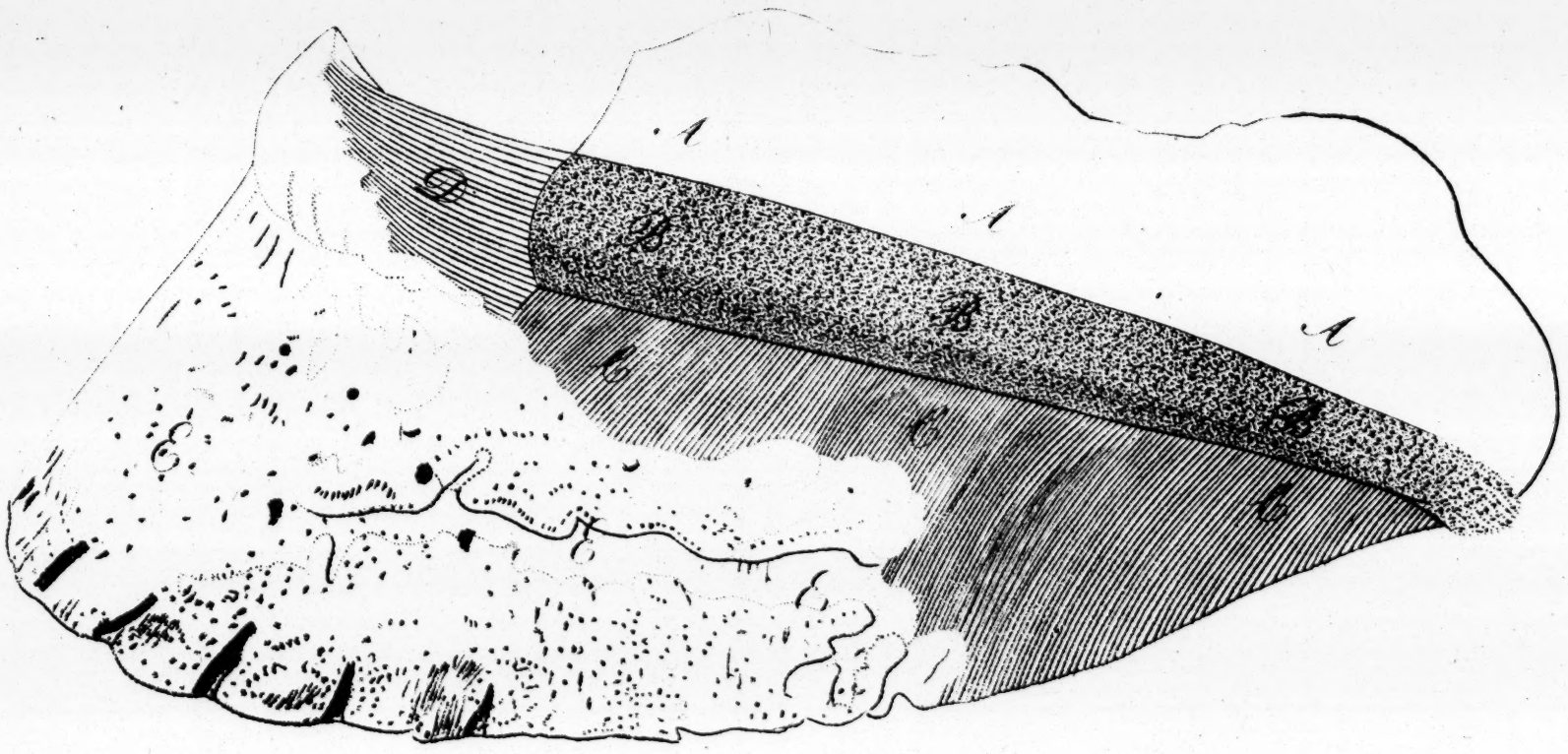

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PLATE VIII. Vol. II.

A VIEW OF THE SENSIBLE SOLE & FROG, RAISED FROM THE COFFIN BONE.

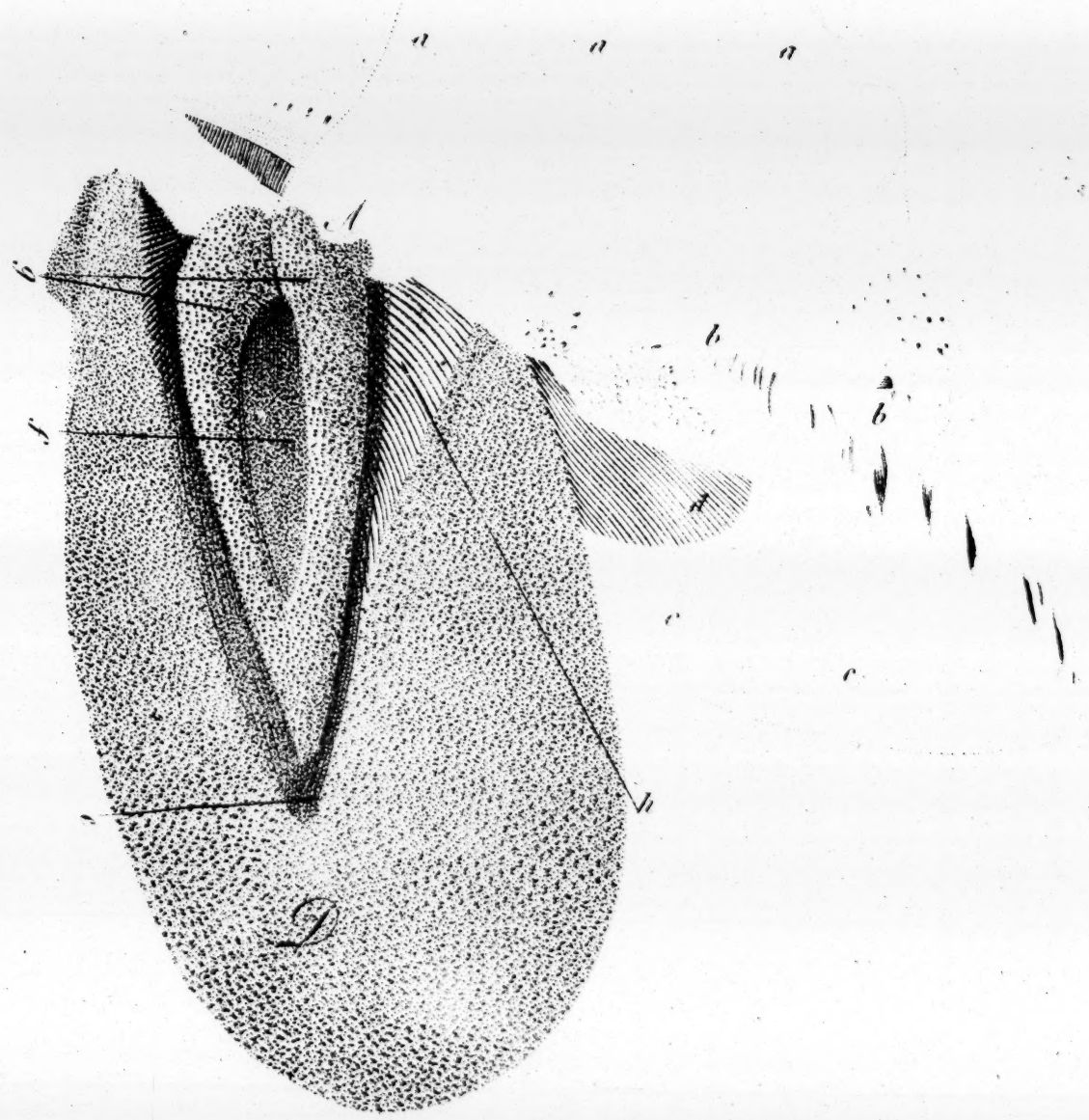

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PLATE VIII.

A VIEW OF THE SENSIBLE SOLE AND FROG RAISED FROM THE COFFIN BONE, &c.

a, a, a.—One of the ſide cartilages.

A.—The lower part of the heel of the ſide cartilage, attached to the heel of the ſenſible frog.

b, b.—The lateral convex ſurface of the coffin bone.

c, c.—The inferior and anterior concave ſurface of the coffin bone, for the attachment of ſenſible ſole.

d.—The poſterior and inferior concave ſurface of the coffin bone, for the inſertion of the long flexor tendon.

D.—The ſenſible ſole, raiſed from the coffin bone, extremely vaſcular, for the purpoſe of ſecreting the horny ſole.

e.—The toe of the ſenſible frog.

f.—A cleft in the ſenſible frog, which receives a correſponding projection of horn from the upper and inner ſurface of the horny frog. The arteries of this part, to abate inflammation from the preſſure of the ſides of the horny frog againſt the ſides of the ſenſible frog, often ſecrete matter called a thruſh.

g, g.—The heels of the ſenſible frog, attached to the heels of the ſide cartilages behind the coffin bone.

h.—The ſenſible laminated bars that ſecrete, and are united to the upper and inner ſurface of the horny bars.

PLATE IX.

A VIEW OF THE FROGS, CARTILAGES, &c.

A, A.—One half of the horny frog.

b, b.—One of the bars.

B.—A cavity between the ſide of the horny frog and one of the horny bars; oppoſed above to part of the ſenſible ſole covering one of the inferior cartilages.

C, C.—One half of the horny ſole.

d, d.—One half of the lower edge of the cruſt that receives the nails.

E.—The junction of one of the bars with the termination of one of the heels of the cruſt behind the coffin bone, forming a flat ſeat for the heel of the ſhoe.

F.—One half of the lower and anterior concave ſurface of the coffin bone, ſtripped of the inſenſible and ſenſible ſole.

G.—The toe of one half of the fatty portion of the ſenſible frog attached to the coffin bone. The horny frog, and the vaſcular ſecreting ſurface of the ſenſible frog, have both been removed.

H.—The heel of the ſenſible frog, attached to the heel of one of the ſide cartilages.

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PLATE IX. Vol. II.

A VIEW OF THE FROGS, CARTILAGES &c.

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I, I.—One of the inferior cartilages attached to the coffin bone, to one of the ſide cartilages, and to one of the lateral edges of the ſenſible frog.

k, k, k.—The line of connection between one of the lateral edges of the ſenſible frog, and the inner lateral edge of one of the inferior cartilages.

L, L, L.—The line of connexion between a projecting edge on the lower ſurface of the coffin bone, and one of the inferior cartilages.

M, M, M.—The line of connexion between the inferior and the ſide cartilages.

N.—The heel of the coffin bone.

O.—The ſeat of corn, oppoſite the heel of the coffin bone.

PLATE

PLATE X.

A VIEW OF THE SENSIBLE LAMINÆ ATTACHED TO THE COFFIN BONE AND HOOF.

A, A, A.—The glandular and highly vaſcular ſurface of the coronary ligament that ſecretes the ſmooth cruſt or wall.

B, B, B.—The ſenſible laminæ that are received between, and ſecrete the horny laminæ. The ſides of the ſenſible laminæ are attached to the ſides of the horny laminæ; above, they are connected to the lower edge of the coronary ligament; by their inner edges, to the perioſteum of the coffin bone, and below, to the edge of the ſenſible ſole.

1, 2, 3.—The villous edge of the ſenſible ſole, extremely vaſcular, for the purpoſe of ſecreting horn, to fill up the oppoſite ſpaces between the old horny laminæ; and thereby to form a bond of union between the whole edge of the horny ſole and cruſt.

4, 5, 6.—The ſmooth cruſt that receives on its inner ſurface the glandular convex coronary ligament. This part of the cruſt is very thin and ſoft at its upper edge, but encreaſes rapidly in thickneſs as it deſcends.

C, C —The external ſmooth ſurface of the cruſt.

D, D.


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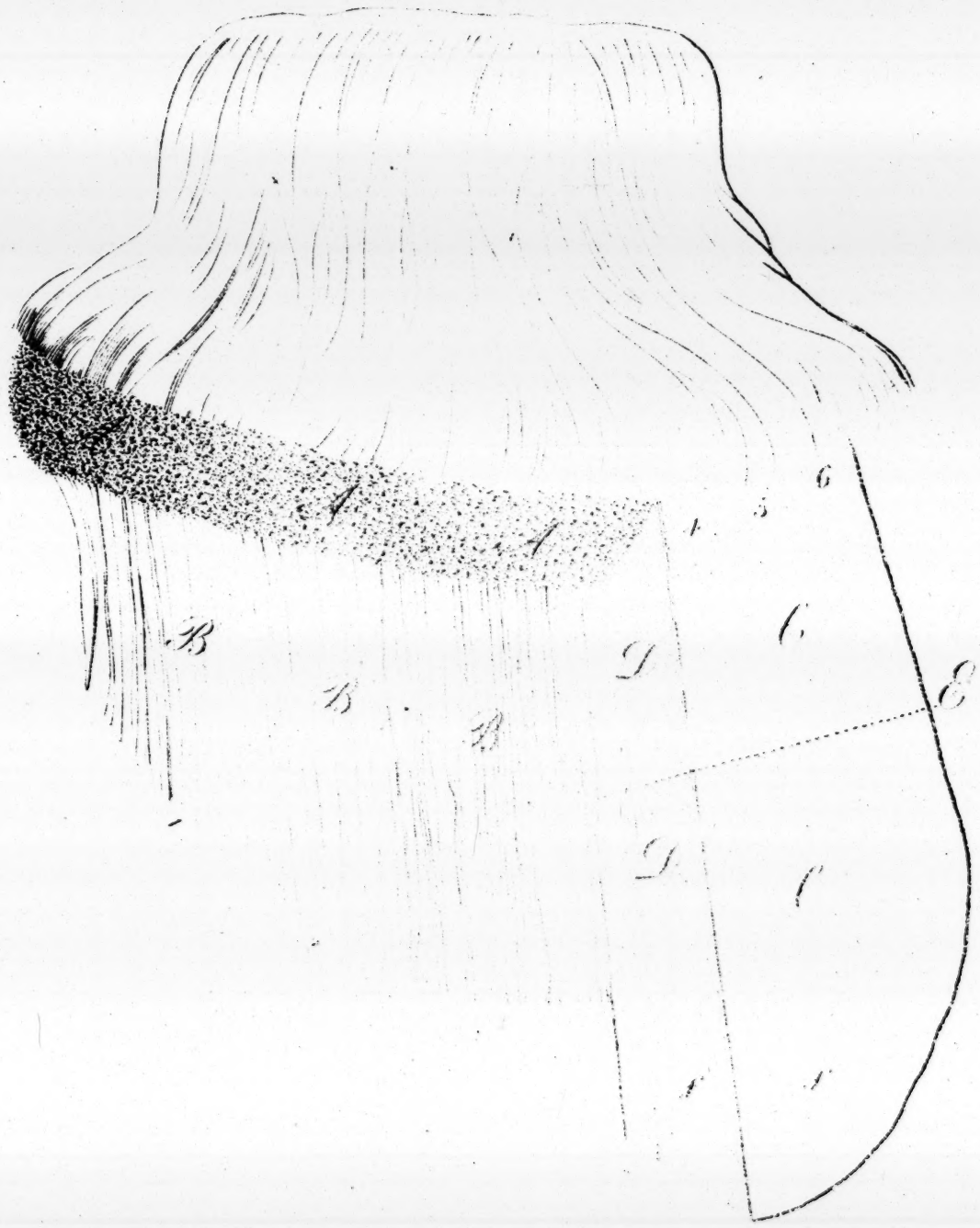
A VIEW OF THE LAMINÆ ATTACHED TO THE COFFIN BONE & HOOF.



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D, D.—A ſection of the cruſt to ſhew its thickneſs, which varies, however, conſiderably in different horſes, and in different parts of the ſame hoof, but is very generally thicker at the toe than at the quarters of the hoof.

E.—A ſection of the horny laminæ.

f, f.—The cruſt below the ſenſible parts of the foot.

PLATE

PLATE XI.

A FRONT VIEW OF THE ARTERIES, &c.

a.—The principle trunk above the fetlock joint, before it divides into the two paſtern arteries.

B, B.—The anterior ſurface of the two ſeſamoid bones covered by cartilage.

2, 2.—A ligament that unites together the inner edges of the two ſeſamoid bones.

C, C.—The large paſtern bone.

D.—The ſmall paſtern bone.

E.—The coffin bone.

f, f.—Two ſmall, but long branches of arteries, which take their origin from the large paſtern artery, near the middle and back part of the large paſtern bone, deſcend obliquely outward, to pour their contents into the inferior coronary artery at i, i.

g, g.—The ſuperior coronary artery, which takes its origin poſteriorly from the ſmall paſtern arteries. Theſe branches then paſs obliquely upward and forward on each ſide of the anterior and upper ſurface of the ſmall paſtern bone, where they unite to form one ſingle artery. The blood in

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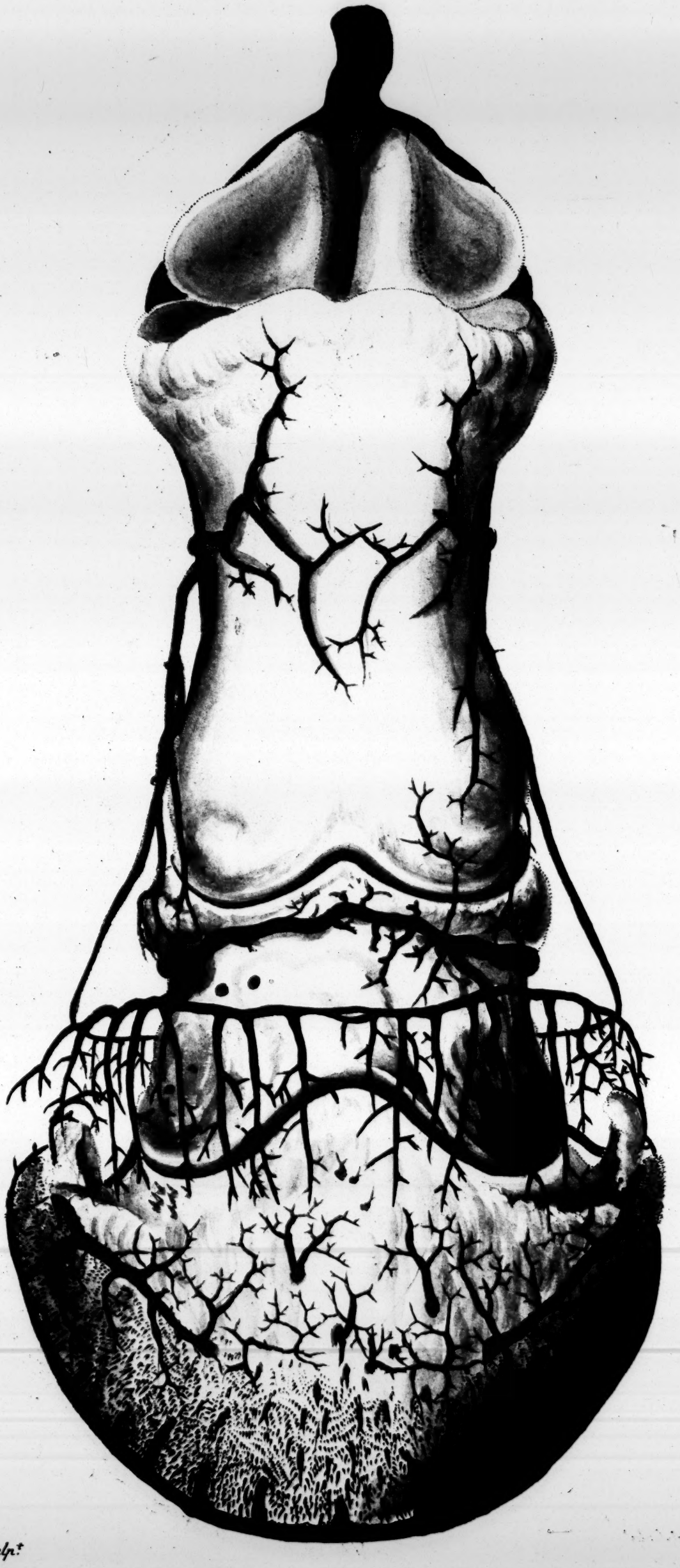

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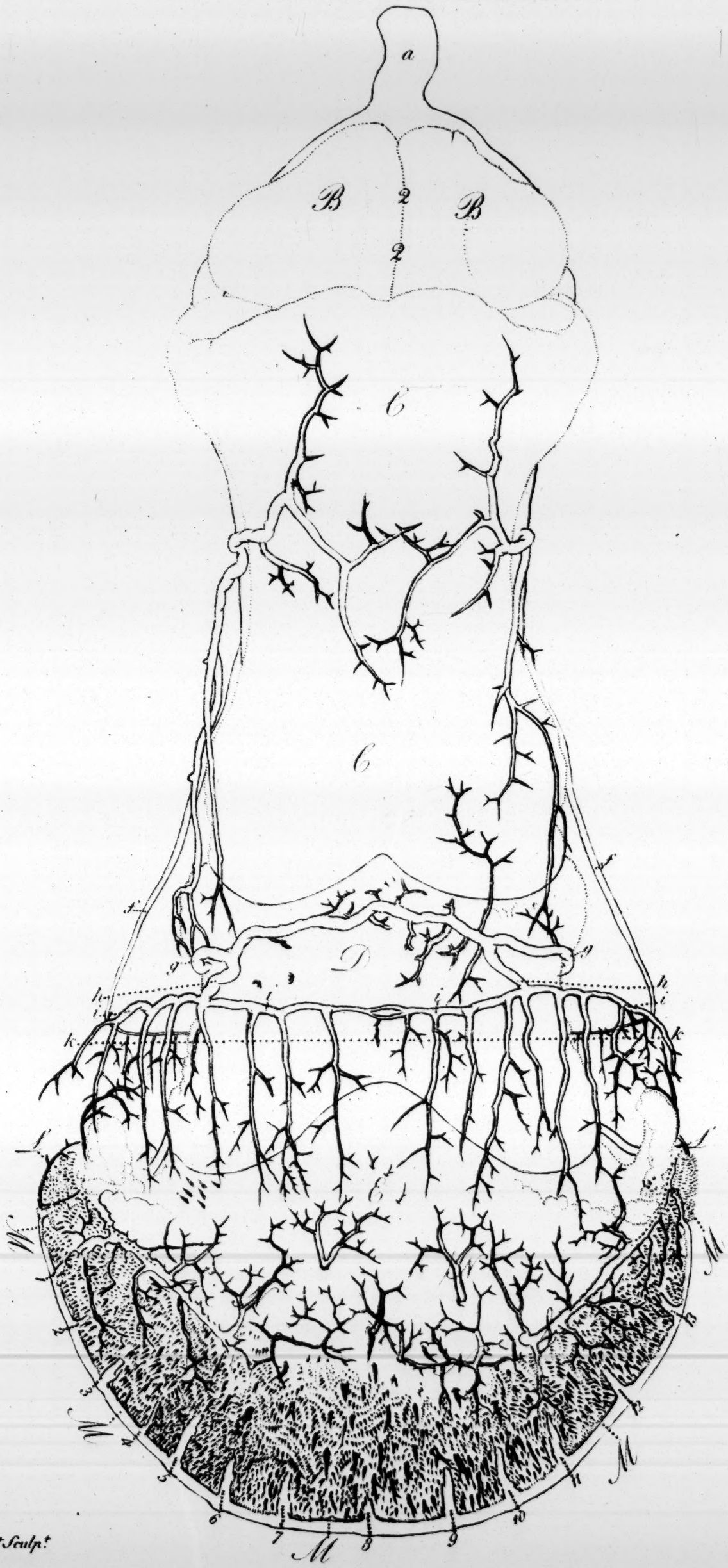
PLATE XI. Vol. II.

FRONT VIEW OF THE ARTERIES.



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the ſuperior coronary artery; from the action of the ſmall paſtern artery on one ſide, being oppoſed by the action of the ſmall paſtern artery on the oppoſite ſide; is forced into the inferior coronary artery.

h, h.—Two ſhort communicating branches of the ſuperior coronary artery, which paſs obliquely outward and downward from the ſuperior into the inferior coronary artery.

i, i, i, i.—The inferior coronary artery in part ſupplied with blood by the two preceding branches of the ſuperior coronary artery, and in part by the two long branches given off by the large paſtern artery, f, f.

k, k.—Small perpendicular veſſels about eighteen in number, which take their origin from the inferior coronary artery i, i, i, i; and paſs directly downward to ſupply the coronary ligament with blood. The ultimate branches of theſe veſſels ſecrete the ſmooth cruſt, and in part ſupply the upper part of the ſenſible laminæ with blood.

L, L, L, L.—Two arteries which take their origin poſteriorly from each of the external coffin arteries, and deſcend obliquely forward and downward, in a ſmall groove in the ſides of the coffin bone, to aſſiſt the ſupply of blood to the ſenſible laminæ.

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13.—Thirteen, and ſometimes fourteen, large arteries that paſs through correſpond-

ing foramina in the lower edge of the coffin bone, to ſupply the anterior coffin artery with blood.

M, M, M, M, M.—The anterior coffin artery, ſupplied with blood from the thirteen principal veſſels, which paſs through correſponding foramina in the lower edge of the coffin bone.

N, N, N.—Numerous ſmall veſſels which paſs through correſponding holes obliquely upwards from within the coffin bone.

PLATE

PLATE XII.

A FULL VIEW OF THE ARTERIES; THE BONES HAVING BEEN REMOVED BY AN ACID.

a.—The trunk of the large metacarpal artery above the fetlock joint.

b, b, b, b, b, b.—The two principal trunks of the large and ſmall paſtern arteries, from the fetlock joint to the coronet.

c, c, c, c.—Two long branches that take their origin laterally from about the middle of the large paſtern arteries, and terminate in the inferior coronary artery.

d, d.—The trunks of two large arteries of the ſenſible frog.

e, e.—A large anaſtamoſing branch, preſerving a free communication between the two principal trunks of the ſmall paſtern arteries.

f, f.—Two branches of arteries that ſupply the anterior part of the glandular ſurface of the ſenſible frog with blood.

g, g.—Two branches that chiefly ſupply the cleft of the frog with blood, and ſecrete an oily fluid, to preſerve the horny frog moiſt, ſoft, and elaſtic.

h, h, h.—The ſuperior coronary artery that ſupplies the inferior coronary artery with blood.

i, i, i.—The inferior coronary artery giving off downwards ſeveral perpendicular ſmall branches, to ſupply the coronary ligament, and the upper part of the ſenſible laminæ with blood, to ſecrete the cruſt.

J, J.—The two principal external coffin arteries that form a curvature obliquely inward, to enter the coffin bone through a foramen on each ſide.

k, k, k, k.—A continuation of the ſame trunk within the coffin bone, united in the centre to form a circulous arterioſus; and, in making this circle, numerous veſſels are given off.

2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2.—Thirteen large veſſels, which take their origin from the lower edge of the circulous arterioſus, and paſs out through correſponding foramina, in the lower edge of the coffin bone, to ſupply the external coffin artery with blood. They are repreſented, for diſtinction, in the finiſhed plate, to contain ſcarlet blood.

L, L, L, L, L, L, L, L.—The external coffin artery that receives all the blood from the thirteen communicating branches within the coffin bone, to form an intermediate connexion between the circulous arterioſus k, k, k, k, and the ſenſible ſole.

M.—A concavity in the centre of the ſenſible frog very vaſcular.

N, N, N.—A ſmall portion of the coffin bone not removed by the acid.

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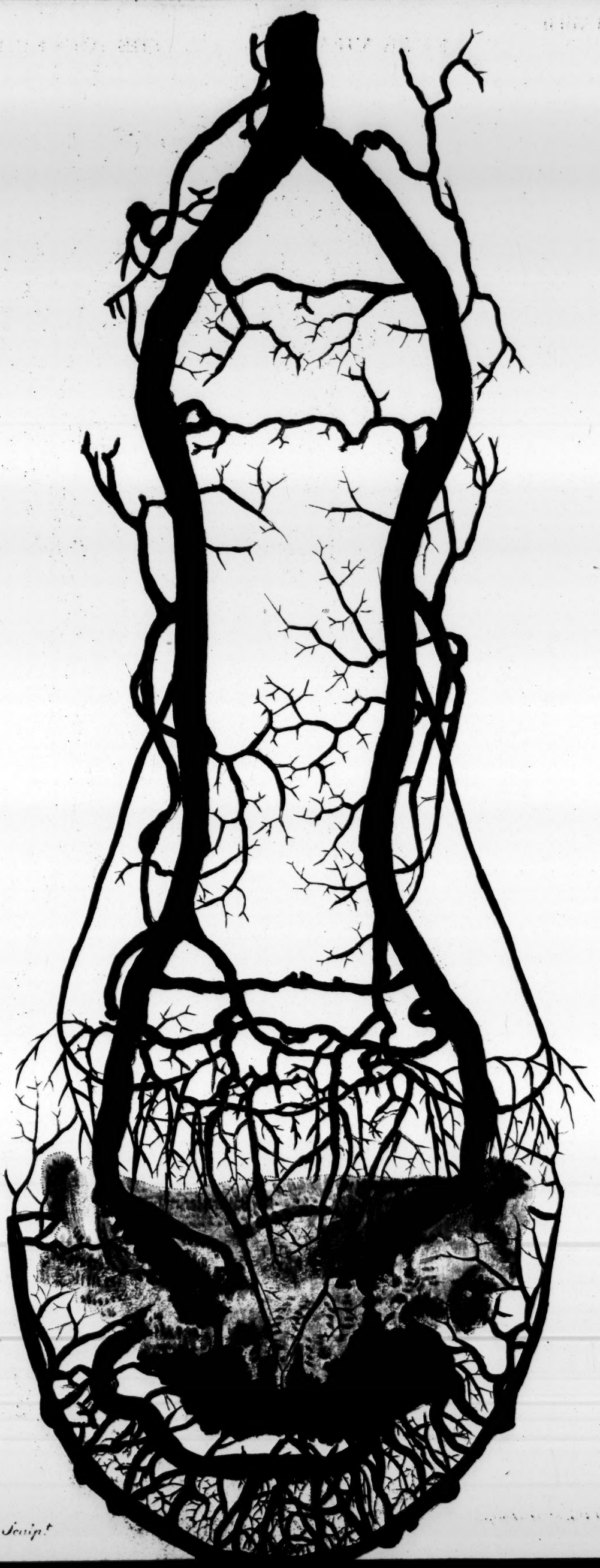

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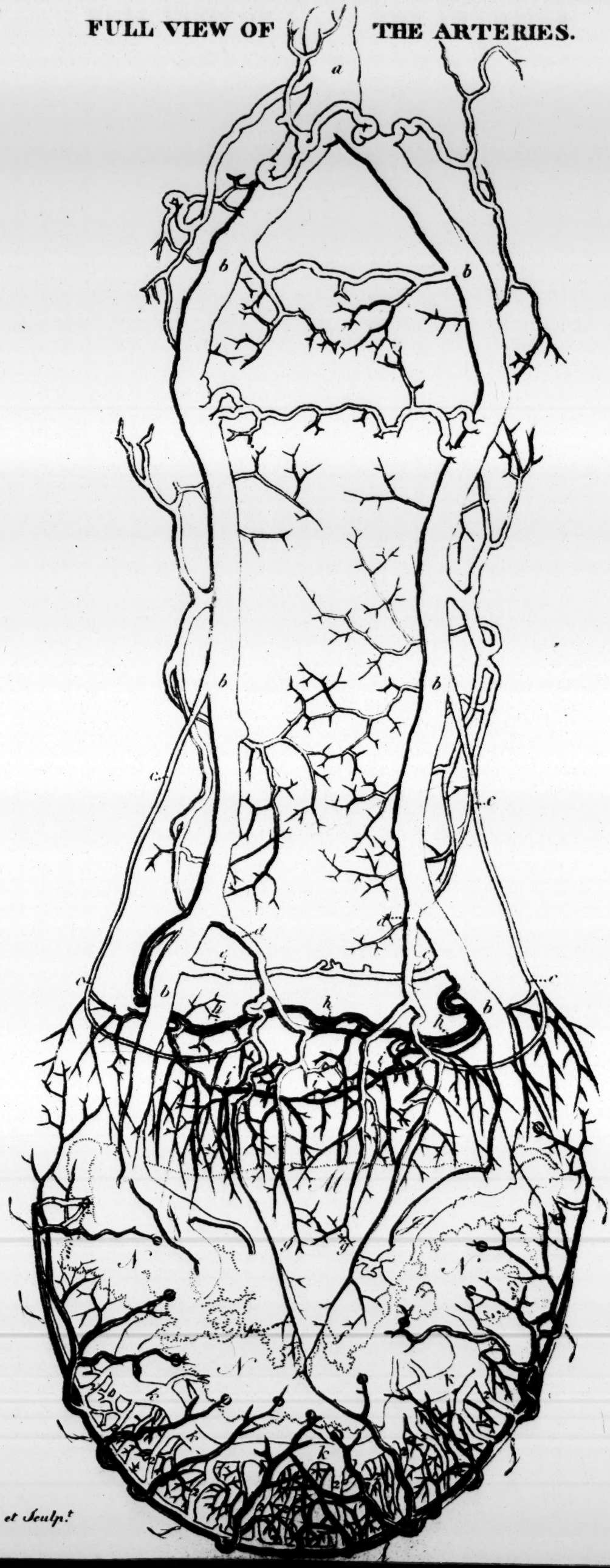
PLATE XII. Vol. II.

FULL VIEW OF THE ARTERIES.



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o, o, o, o, o, o, o, o, o, o, o, o, o.—Thirteen arteries that take their origin from the external coffin artery L, L, L, L, L, L, L, L, and are then diſtributed to the lower ſurface of the coffin bone, to ſupply the ſenſible ſole with blood. Theſe arteries are repreſented to contain a dark coloured blood, to diſtinguiſh them from the ſame number of veſſels that bring the blood from the circulous arterioſus within the coffin bone into the external coffin artery. Although theſe veſſels generally correſpond in number, they are not a continuation of the arteries of the circulous arterioſus, but a diſtinct ſet of veſſels; and, from containing blood that has firſt paſſed through the external coffin artery, the circulation in the ſmall branches of the ſenſible ſole is neceſſarily rendered ſlow. The blood is ſtill farther retarded in its progreſs, by the occaſional preſſure the ſenſible ſole receives from the coffin bone above, and horny ſole below.

PLATE

PLATE XIII.

A FRONT VIEW OF THE VEINS AND ARTERIES.

A.—The lower head of the cannon bone.

b.—The large paſtern bone.

c.—The ſmall paſtern bone.

d, d, d, d, d, d.—The two principal veins of the large and ſmall paſtern bone, that return all the blood from the foot.

e, e.—The inferior coronary artery. The other arteries of the foot are obſcured by the numerous veins.

F, F, F, F.—Innumerable ſmall veins that cover the convex ſurface of the coffin bone, and aſcend obliquely to carry the blood from the ſenſible laminæ and ſenſible ſole, to larger veins within and above the coronary ring. Theſe veſſels are ſo numerous, and communicate ſo freely with each other, that ſcarcely any accidental preſſure could totally obſtruct the circulation.

g, g, g, g, g, g, g.—The anterior and inferior coffin vein attached to the edge of the coffin bone. This veſſel receives blood from the veins of the ſenſible ſole, and conveys it into innumerable ſmall veins immediately above the lower edge


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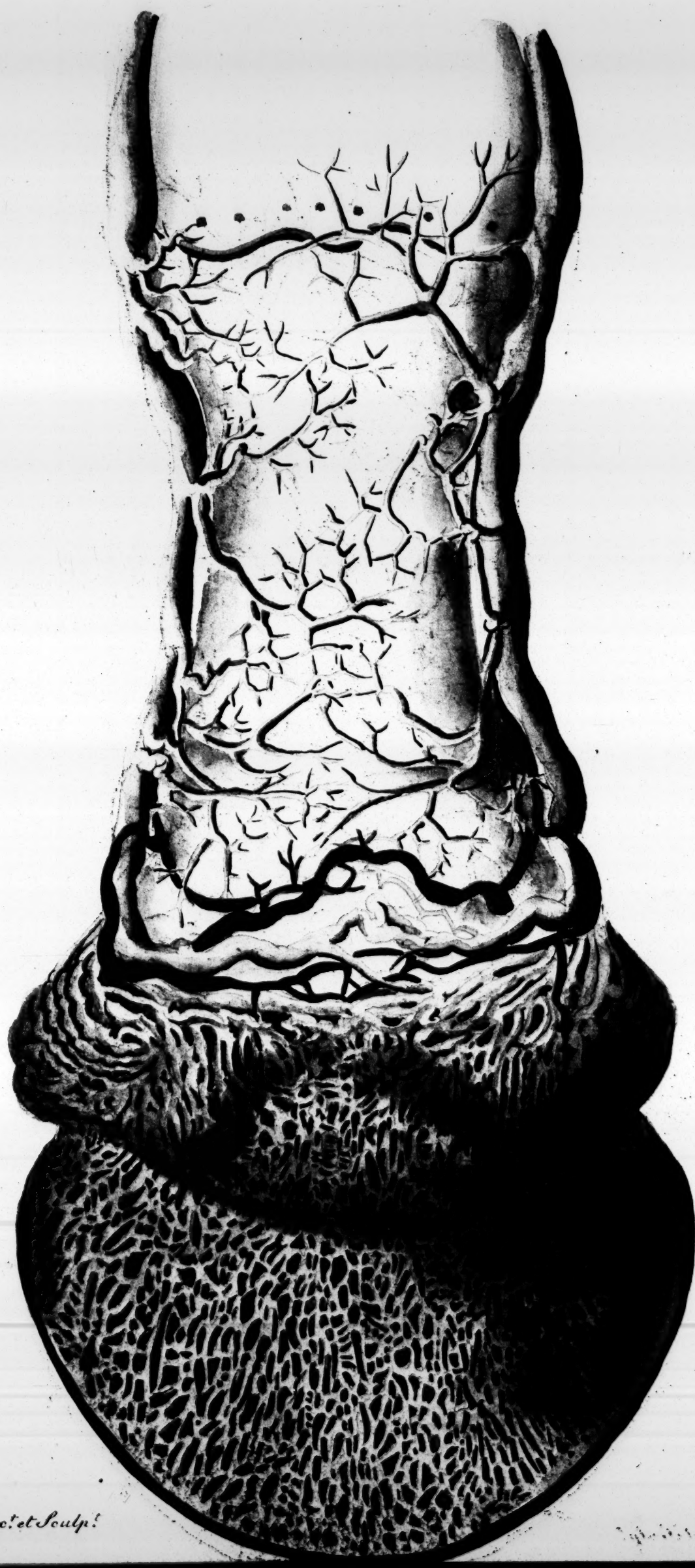

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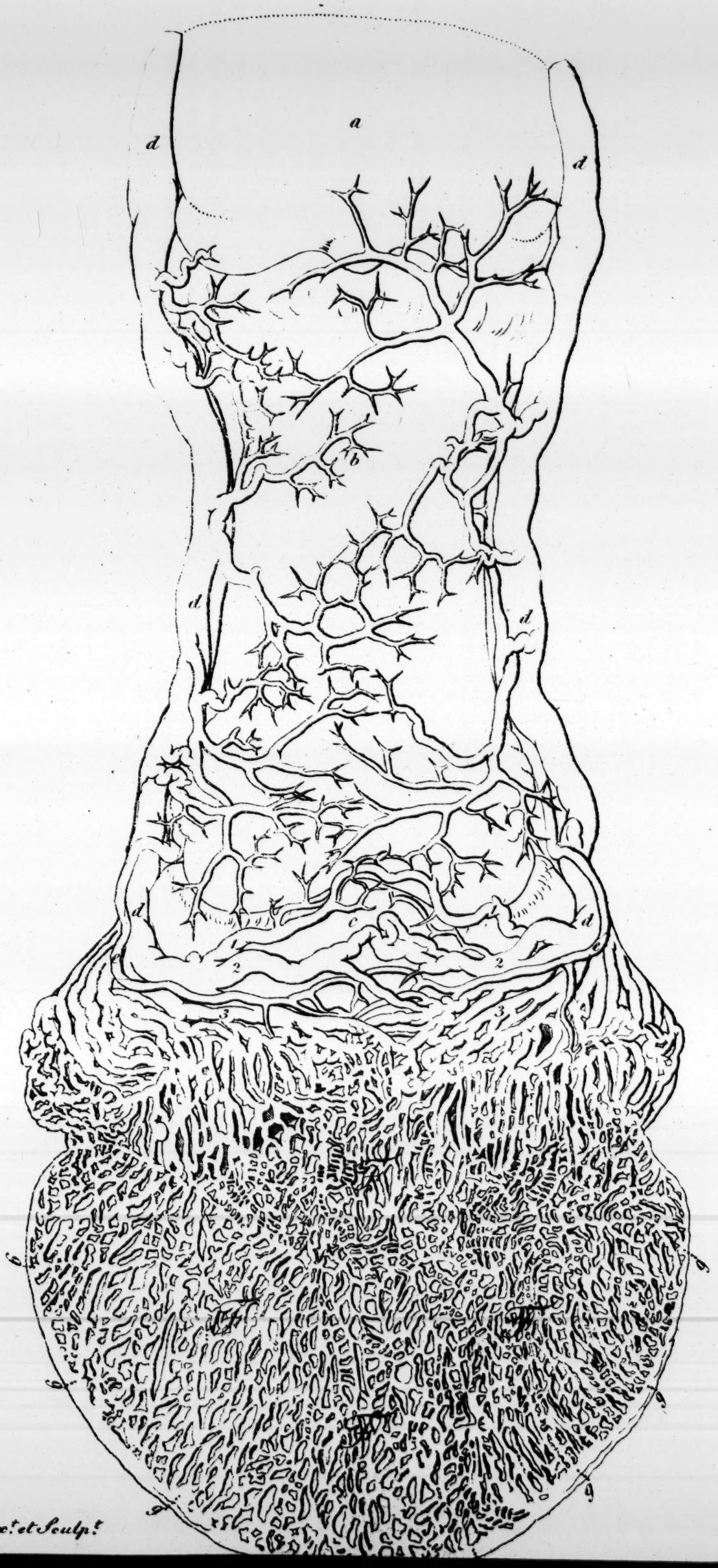
PLATE XIII. Vol. II.

FRONT VIEW OF THE VEINS & ARTERIES.



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edge of the coffin bone, while the artery correſponding to this vein imparts blood to the ſenſible ſole.

3, 3.—The inferior coronary vein that receives a conſiderable portion of blood from the veins of the coronary ligament and ſenſible laminæ, and terminates on each ſide in the paſtern veins.

2, 2.—The ſuperior coronary vein which receives blood from the inferior coronary vein, and laterally from ſeveral large veins covering the ſide cartilages. This vein terminates on each ſide into the paſtern veins.

i, i.—A large anaſtamoſing branch connected at both ends with the upper coronary vein, ſo that any preſſure applied to the centre of the upper or lower coronary vein would not obſtruct the circulation.

PLATE

PLATE XIV.

A BACK VIEW OF THE VEINS, ARTERIES, NERVES,

AND NEWLY FORMED BRANCHES OF VEINS, IN CONSEQUENCE OF THE APPLICATION OF A LIGATURE.

a.—The principal trunk before it divides into the two large paſtern arteries, injected with red injection.

b, b.—The two large paſtern arteries on the inner ſide of the veins.

c, c, c, c.—The two large paſtern veins injected with yellow injection.

d, d, d, d, d.—A conſiderable number of branches of veins newly formed, in conſequence of the circulation being ſtopped in the principal trunks on each ſide, from the application of a ligature. Theſe veſſels are paſſing upward on each ſide, from the paſtern veins at the loweſt d, d, below the parts where the ligatures were applied; to the paſtern vein on each ſide above the ligatures at the upper d, d.

* *.—The part where a ligature ſurrounded the principal trunk of the vein on each ſide.

e, e, e.—A ſmall branch of a vein which naturally keeps up a communication between the two veins, but enlarged from the


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PLATE XIV. Vol. II.

BACK VIEW OF THE VEINS & ARTERIES, &c.

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the circulation being obſtructed in the trunks, to a greater ſize than either trunk. This branch paſſes obliquely from the large paſtern vein on one ſide below the ligature, to the paſtern vein on the oppoſite ſide above the ligature. All theſe veſſels jointly carried on the circulation ſo perfectly, that the total obſtruction in the principal trunks produced no lameneſs, or other inconvenience.

F, F, F, F.—The arteries and veins of the ſenſible ſole. The arteries injected with red, the veins with yellow injection. The veins here form very frequent communications with each other, ſo as to prevent any ill effects from the preſſure of the ſenſible ſole between the coffin bone above, and horny ſole below.

g, g, g, g.—The two principal nerves, ſituated on the inner ſide of the arteries.

h, h,—Two large branches of nerves paſſing over the cartilages, and diſtributed to the ſenſible laminæ and coronary ligament.

i, i.—Two branches of nerves diſtributed to the ſenſible frog.

PLATE XV.

A VIEW OF THE ABSORBENTS AND NERVES.

a, a, a, a, a, a, a, a.—The inferior extremities of four abſorbents on each ſide coloured with green, to diſtinguiſh them from the nerves.

b, b, b, b, b, b, b, b.—The upper ends of the ſame abſorbents cut off above the paſtern joint.

c, c.—The two principal nerves, one on each ſide, cut off a little above the large paſtern joint, giving off three principal branches in their deſcent to the foot.

d, d, d.—Several ſmall filaments of nerves given off to the coronary ligament and ſenſible laminæ.

e, e, e, e.—Several ſmall filaments given off on the inſide of the cartilages.

f.—A large branch diſtributed to the ſenſible frog.

G.—The external ſurface of one of the ſide cartilages.

H.—The lateral porous ſurface of the coffin bone.

i, i, i.—A branch of a nerve paſſing through a foramen in the coffin bone, to be diſtributed to the ſenſible laminæ.

K, K, K.

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PLATE XV. Vol. II.

VIEW OF THE ABSORBENTS & NERVES

London, Published as the Act Directs 1802, by Edward Coleman, Professor of the Veterinary College, 1802.


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K, K, K.—One half of the fatty portion of the ſenſible frog ſtripped of its vaſcular covering, to ſhew its attachment to the heel of one of the ſide cartilages.

L.—The toe of the ſenſible frog attached to the coffin bone.

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